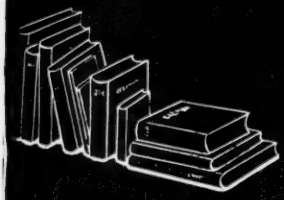
ABSTRACTS OF NORTH AMERICAN GEOLOGY



RAYMOND H. FOGLER LIBRARY
UNIVERSITY OF MAINE
ORONO, MAINE 04473

JULY 1968

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

N

UNIT

ABSTRACTS OF NORTH AMERICAN GEOLOGY

July 1968

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1968

T 12 54

UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402.
Price 45 cents (single copy). Subscription price: $5.00 a year (12 monthly issues); $1.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (December 8, 1965).
(exp. 12-68)

ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

Abstracts of North American Geology and the Bibliography are prepared by use of computer techniques. Each abstract, along with its indexing, is placed on magnetic tape and entered into a permanent data bank. The material prepared each month is published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242.

The abstracts in this issue were prepared by W. L. Adkison, Georgianna D. Conant, Howard R. Cramer, W. C. Culbertson, Leonard M. Gard, Jr., Catharina R. Groot, Bettie S. Hackman, John W. Hosterman, Virginia M. Jussen, B. H. Kent, R. A. Loney, Elisabeth S. Loud, Mildred C. Mead, E. A. Merreweather, A. G. Milnes, Donal R. Mullineaux, Willis H. Nelson, Virginia S. Neuschel, J. C. Olsen, A. Thomas Ovenshine, Allison R. Palmer, Louis L. Ray, K. A. Richey, Katherine A. Summer, Vernon E. Swanson, Dorothy B. Vitaliano, Donald E. White, and Ray E. Wilcox.

ABSTRACTS

05996 **Abrahams, S. C.** Detection of inversion centers using the Patterson function [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 48–51, 1967.

The three-dimensional Patterson function for a crystal with n atoms in the unit cell and space group $P\bar{1}$ contains n^2-n vectors, which are the vector differences between the coordinates of the atoms. For space group $P\bar{1}$, there are only $n^2/2$ vectors, of which n have coordinates *double* those of the atoms. Expressions, suitable for use on a computer, are developed based on this simple distinction. Routine identification of inversion centers by machine analysis of the Patterson function may thus be made.—Author's abstract

06171 **Adachi, Shohei.** A theory of stability of streams [with French abs.], Paper A42 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 338–344, illus.; discussion and reply, ibid., V. 5, p. 137, 145, 1967.

In this paper stability of the streams is treated theoretically by using the small amplitude oscillation theorem to find flow factor contributing the origin of meandering. In order to express the lateral variations of a stream the mean quantities with respect to the flow depth are introduced into the basic equations. By assuming that any disturbance may be superposed on the stationary flow, the stability equation for the lateral variations is formulated. Although the complete solution has not been found, the conditions of the neutral disturbance have been obtained.—Author's abstract

06140 **Aitken, J. D.; Greggs, R. G.** Upper Cambrian formations, southern Rocky Mountains of Alberta, an interim report: Canada Geol. Survey Paper 66-49, 91 p., illus., 1967.

The Upper Cambrian of the region, up to 5,000 feet thick in the Main Ranges and thinning northeastward toward the Plains, comprises three cycles of deposition: Arctomys–Waterfowl, Sullivan–Lyell, and Bison Creek–Mistaya Formations. Each cycle begins with shales above a thick interval of carbonate rocks; shallow deposition is evident, the interbedded layers of the first half of the cycle grading upward into carbonate rocks of the second half. Definitions are revised for the Arctomys (restricted), Sullivan, and Lyell Formations; several other formations are invalidated; and three new ones are erected—the Waterfowl, Bison Creek, and Mistaya Formations—in the Glacier Lake–Mount Murchison area. The Lynx Formation is raised to group rank. Type sections are in an appendix.—GDC

Akimoto, S. *See* Kushiro, I. 06412

00281 **Akimoto, Syun-iti; Fujisawa, Hideyuki.** Olivine spinel solid solution equilibria in the system Mg_2SiO_4–Fe_2SiO_4: Jour. Geophys. Research, v. 73, no. 4, p. 1467–1479, illus., tables, 1968.

Olivine spinel solid solution equilibria in the system Mg_2SiO_4–Fe_2SiO_4 have been studied over the pressure range 43 to 96 kb at 800°, 1000°, and 1200°C with the aid of tetrahedral anviltype high pressure apparatus. From the compositions of coexisting olivine and spinel solid solutions, the transition pressure of Mg_2SiO_4 from olivine to spinel structure was calculated to be 127 kb at 800°C, 140 kb at 1000°C,

and 151 kb at 1200°C. The olivine–spinel transition in the mantle was concluded to begin at 370 km at a temperature of about 1150°C, when composition of the mantle olivine is assumed at $(Mg_{0.9}Fe_{0.1})_2SiO_4$. Spinel and olivine solvus curves suggest that the two-phase region ranges from 18 to 28 kb (50- to 80-km width) in the mantle.—Authors' abstract

Akright, Robert. *See* Hausen, D. M. 06279

Albee, Arden L. *See* Smith, Douglas. 06105

06215 **Allaway, W. H.** Selenium content of forage crops in relation to muscular dystrophy in livestock [abs.], *in* Relation of geology and trace elements to nutrition—A symposium, New York, 1963: Geol. Soc. America Spec. Paper 90, p. 10, 1967.

05990 **Allen, Albert E., Jr.** Environments of deposition in the Minnelusa and their interpretation from gamma sonic logs [abs.], *in* Symposium on recently developed geologic principles and sedimentation of the Permo-Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf., Casper, 1966: Casper, Wyo., Petroleum Inf., p. 91–94, illus. [1967?].

Anders, Edward. *See* Studier, Martin H. 00291

Anders, Edward. *See* Hayatsu, Ryoichi. 00294

06160 **Anderson, Alvin G.** On the development of stream meanders [with French abs.], Paper A46 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 370–378, illus.; discussion, ibid., V. 5, p. 138–139, 146–147, 1967.

From published observations and results of an experimental analysis, an attempt is made to develop a model with features that would relate the mean length of alternate bars in straight alluvial channels and hence the meander length of meandered streams to the flow parameters. Based upon a concept of transverse oscillations, the relative meander length is related to the Froude number of the mean flow and through the Froude number to the discharge. These results are compared with experimental data for the meanders generated in laboratory channels at constant discharge with generally good agreement. The analysis also suggests that there is no unique relationship between meander length and discharge.—*from* Author's abstract

06411 **Anderson, Don L.; Kovach, Robert L.** The composition of the terrestrial planets: Earth and Planetary Sci. Letters, v. 3, no. 1, p. 19–24, illus., tables, 1967.

Mean atomic weight is the common parameter. Recent satellite and radar observations show that the Martian density is 3.96 to 4.10 g/cm^3; that of Venus, 5.27, and that of Mercury 5.50 g/cm^3. These are used to calculate mean atomic weight: Mars is 25.3.±4; Venus, 26.4; Mercury, 36.0; the Moon, 22.0, and the Earth, 27.0. In comparison, mean atomic weights of meteorites and various rocks are: igneous rocks, 21–22; carbonaceous chondrites, 23.4–24.0; ordinary chondrites 24.4; "high-iron" chondrites, 25.1; enstatite chondrites, 25.6; and iron meteorites, 55.—*from* Authors' abstract

Anderson, G. M. *See* Hamilton, D. L. 06231

00265 **Anderson, K. H.; Wells, J. S.** Forest City basin of Missouri, Kansas, Nebraska, and Iowa: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 264–281, illus., 1968.

Initial movements of the Ozark uplift and Chatauqua arch began in Late Ordovician time; attendant subsidence in northern Kansas formed a basin which was later bisected by the Nemaha anticline. Post-Mississippian, pre-Atokan peneplanation preceded renewed uplift of the Nemaha anticline and downwarping of the area to the east to form the Forest City basin which was separated from the Cherokee basin to the south until middle Cherokee time. Northeast trending folds developed after

Mississippian deposition, whereas previous structural orientation was northwestward.—WLA

06163 **Anding, Malcolm G.; Pierce, Paul W., 3d.** Some relations of energy, roughness, and channel geometry in the Lower Mississippi River [with French abs.], Paper A48 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 389–397, illus.; discussion, ibid., V. 5, p. 147–150, 1967.

Investigations by the U.S. Army Corps of Engineers in the Vicksburg District of the lower Mississippi River concern hydraulic variables related to sediment transport in large alluvial streams, design criteria for river control structures, and evaluation and prediction of effects of existing and proposed channel stabilization; improved surveying and drafting procedures permit more detailed coverage. Basic studies and investigations are described and related to channel types and alignment encountered. An energy–roughness concept is presented in which important variables are related to the energy slope; data for two representative reaches permit comparisons. Implications and possible applications of energy–roughness principles to river engineering are discussed.—GDC

06188 **Andrews, Donald E.; Schmidt, Paul W.; vanOlphen, H.** X-ray study of interactions between montmorillonite platelets, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 321–330, illus., table, 1967.

Small angle scattering curves have been obtained for a series of Wyoming Na bentonite clay samples containing 10 percent clay by weight and $NaPO_3$ in concentrations ranging from 0 to 100 meq/l. From the scattering data, the relative probability of spacings between parallel clay platelets was computed. As the concentration of $NaPO_3$ increased, the maximum became sharper and occurred for smaller inter–particle distances. The similarity of the dependence of the position d of the maximum on $NaPO_3$ concentration and its dependence on NaCl suggests that interparticle spacing depends on the sodium ion. The value of d appears to be independent of the method of gel preparation. Since the Na ions act to reduce the double–layer repulsion between platelets, the value of the most probable interparticle distance appears to be determined primarily by the magnitude of this repulsion.—*from* Authors' abstract

00362 **Andrews, Henry N.; Kasper, Andrew; Mencher, Ely.** *Psilophyton forbesii*, a new Devonian plant from northern Maine: Torrey Bot. Club Bull., v. 95, no. 1, p. 1–11, illus., 1968.

A new species of *Psilophyton*, *P. forbesii*, is reported from the upper Lower Devonian [Trout Valley Formation, Traveler Mountain quadrangle] in northern Maine. The plant is characterized by a strong central (monopodial) stem up to 9 mm in diameter with dichotomously forking side branches; spines or emergences are lacking; the ovoid sporangia were borne in terminal pairs and measure approximately 3.5 to 4.0 mm long and 1.3 to 1.8 mm in greatest diameter. A brief account is given of other early Devonian plants from Maine that are under study in the authors' laboratory, and two recent studies by H. P. Banks [1968] and F. M. Hueber [and Banks, 1967] bearing on the classification of the psilophytes and the status of *Psilophyton* are reviewed.—*from* Authors' abstract

06297 **Antman, Herbert S.** The State's role in oceanography, *in* The new thrust seaward—MTS Conf. and Exhibit, 3d Ann., San Diego, Calif., 1967, Trans.: Washington, D. C., Marine Technology Soc., p. 1–4, 1967.

An attempt has been made to point out some of the implications of oceanography on the State and local levels. Oceanography here has been interpreted in terms of marine resources and their development. Economic, educational and governmental aspects were examined. Specific attributes of New York State are discussed, such as its financial capability, water resource management, Long Island's marine resources, joint university interest in oceanography, local MTS–NY Section activity in stimulating public interest, and State and Federal support of

oceanography. Finally, some recommendations are made for increasing and enhancing oceanographic development.—Author's abstract

Appelgren, Bo G. *See* Rahm, S. Lennart. 06156

Appleman, Daniel E. *See* Takeda, Hiroshi. 05985

Appleman, Daniel E. *See* Takeda, Hiroshi. 06008

06366 **Aronson, J. R.; Eckroad, S. W.; Emslie, A. G.; McConnell, R. K., Jr.; Thüna, P. C. von.** Radiative thermal conductivity in planetary interiors: Nature, v. 216, no. 5120, p. 1096–1097, table, 1967.

In an experimental study of radiative transfer in minerals by Aronson and others (1967) the effect of high temperatures on optical constants of minerals was examined and a detailed theory of backscattering was developed. An interesting result of the theory is that diffuse backscattering is caused almost entirely by refraction rather than by reflection when the relative refractive index across particle boundaries is less than 4. MacDonald (1959) indicated that <0.03 W per cm°K estimates of the 1,500°K radiative conductivity appeared to be necessary in calculations of the thermal history of the Earth, although values suggested by rock temperature spectrums of olivines were more than a magnitude higher. The results presented here may help to resolve this apparent difficulty.—DBV

06161 **Ashida, K.; Tanaka, Y.** A statistical study of sand waves [with French abs.], Paper B12 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 2: Fort Collins, Colo., Colorado State Univ., p. 103–110, illus., tables; discussion and reply, ibid., V. 5, p. 248–250, 260–261, 1967.

This paper deals with the statistical characteristics of sand waves which should be useful for describing the bed roughness quantitatively. The authors obtain analogue and digital records of bed elevation as a function of both distance and time by a super-sonic sounder for various regimes of bed forms: namely, ripples, dunes, transition and standing waves. The characteristics of autocorrelation and spectral density function are discussed with relation to the bed regimes. The process of bed elevations for both dunes and standing waves is approximately represented by a Markov second-order linear process but the process for both ripples and transition should be represented by higher order Markov process. The authors also discuss the relation between two spectral density functions concerning distance and time. Moreover, the authors discuss the distribution of the save heights and lengths.—Authors' abstract

06104 **Auffenberg, Walter.** Notes on West Indian tortoises: Herpetologica, v. 23, no. 1, p. 34–44, illus., table, 1967.

Newly discovered material of *Geochelone sombrerensis* (Leidy, 1868) from Pleistocene fissure deposits of Sombrero Island is described. Fragments of plastron, humerus and femur, and a complete tibia are compared with *G. cubensis and G. monensis* (from Pleistocene of Cuba and Mona Island) and it is clear that *sombrerensis* is closely related to these species, possibly closer to *monensis*. Fragments of *Geochelone* spp. are reported for the first time from Pleistocene deposits of Bahama Islands (New Providence and Andros) and Navassa Island. Some of the Navassa material is similar to *sombrerensis*, but the Bahama material appears to be distinct from the above three species. *Geochelone* will probably be found eventually in older Pleistocene cave and fissure deposits on the remaining Greater Antillean islands.—VMJ

06067 **Axford, W. I.** The magnetosphere, *in* The Earth in space (Hugh Odishaw, editor): New York and London, Basic Books, p. 117–125, 1967.

This is a popular account of the magnetosphere. Its origin from the magnetic field, its distribution about the Earth, and its general properties are described; however, no new information is included.—HRC

00187 **Ayres, L. D.** Trout Lakes area, South Trout Lake sheet, District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 422, scale 1 in. to 1/4 mi., text, revised 1968; originally published 1967.

00188 **Ayres, L. D.** Trout Lakes area, Rathouse Bay sheet, District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 439, scale 1 in. to 1/4 mi., text, 1968.

Except for mafic metavolcanic and metasedimentary inclusions, a 25-ft wide diabase dike, and five thin mafic sheets, all rocks in the map-area are part of the early Precambrian North Trout Lake granitic batholith; sparse, mafic metavolcanic inclusions are present in about 10 percent of the granitic outcrops. The batholith is a composite intrusion ranging in composition from quartz diorite to granite. Bedrock is poorly exposed in some areas because of extensive deposits of Pleistocene varved clay and silt. Minor faults and shear zones are found, but only three faults are large enough to show on the map. Narrow quartz veins containing trace amounts of sulfide minerals were rarely found in the granitic rocks; concentrations of sulfide minerals were found at two localities only.—MCM

06326 **Ayrton, W. G.** Chandler—Port-Daniel area, Bonaventure and Gaspé-South Counties [also French edition]: Quebec Dept. Nat. Resources Geol. Rept. 120, 91 p., illus., tables, geol. maps, 1967.

Oldest rocks are the pre-Middle Ordovician Maquereau Group, divided into three named formations. Other units named are the North Port-Daniel River Complex, Raudin Group, and Weir Formation. Flat-lying Carboniferous rests unconformably on the older groups. The Maquereau Group acted as a block through Taconic and Acadian orogenies; surrounded by faults, its complex folding pattern was acquired in the Gaspesian orogeny. The main pulse of the Taconic was at the end of Middle Ordovician, and the Acadian during Late Devonian. There is no Appalachian folding in the area. The Weir Township serpentinite, intruded during the Taconic, was remobilized during the Acadian. Glassy welded tuffs may be Tertiary. Economic possibilities are discussed. Two block diagrams, a Silurian section, and five geologic maps are included.—ESL

00181 **Baars, D. L.; Campbell, J. A.** Devonian System of Colorado, northern New Mexico and the Colorado Plateau: Mtn. Geologist, v. 5, no. 1, p. 31-40, illus., tables, 1968.

The Devonian is a thin sequence of stable-shelf sandstones, shales, and carbonates. On the Plateau, the Aneth Formation is at the base, where conditions were euxinic. This is overlain and overlapped by the Elbert Formation which is from a tidal flat environment. The Ouray Formation overlies this everywhere; it is a low-energy environment deposit. The Chaffee Group occurs in central Colorado, and is a marginal, marine, transgressive formation in part a facies of the Plateau section. In eastern Colorado, the Williams Canyon Formation correlates in part with the Chaffee Group. No Devonian occurs in northeastern Colorado or northeastern New Mexico.—*from* Authors' abstract

06116 **Bailey, S. W.** (editor). Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), 487 p., illus., tables, 1967.

Symposia on electron-optical study of smectites (3 papers), X-ray diffraction analysis (3 papers), mixed layer minerals (2 papers), high temperature reactions (2 papers), spectroscopic techniques (3 papers), vermiculite studies (3 papers), and zeolites (7 papers) comprise almost half the volume; the remainder consists of 21 general papers. Thirty-seven papers are cited separately.—ESL

Bailey, S. W. *See* Mossman, M. H. 06187

06389 **Baird, A. K.; McIntyre, D. B.; Welday, E. E.; Morton, D. M.** A test of chemical variability and field sampling methods, Lakeview Mountain Tonalite, Lakeview Mountains, southern California batholith, *in* Short contributions to California

geology: California Div. Mines and Geology Spec. Rept. 92, p. 11–19, illus., tables, 1967.

A preliminary investigation was made in the part of the southern California batholith exposed in Riverside County for a sampling plan adequate to map relative amounts of major and minor chemical elements. Minimum specimen size for this tonalite appears to be controlled mainly by grain size rather than layering. From rock specimens collected both by diamond drill and by hammer, 174 powders were analyzed in duplicate for Na, Mg, Al, Si, K, Ca, Ti, and Fe, by X-ray fluorescence. Statistically, results indicate that core segments at least 3 in. long and 7/8 in. in diameter are adequate specimens for quantitative chemical analysis. To overcome relatively high chemical variability between specimens at 5-ft intervals, contributed to by schlieren, it is suggested for regional mapping that 9 specimens, collected 50 feet apart at each grid point, be combined into one composite sample.—GDC

06072 **Baker, R. G.** Preliminary study for determining magnitude from Lg: Earthquake Notes, v. 38, no. 1, p. 23–28, illus., 1967.

A technique is discussed for the possible use of the Lg phase for magnitude determination for regional and near regional events. Data used in this study were obtained from several test shots at the Nevada Test Site recorded by Long Range Seismic Measurements stations. The comparison of magnitudes determined by this method appears to give better results for epicentral distances up to about 2,000 km than the body wave technique presently in use. This research is the result of a preliminary investigation to determine the feasibility of the method and further study is continuing.—Author's abstract

06405 **Ballance, W. C.** Arkansas River basin—Geography, geology, and hydrology, *in* Water resources of New Mexico (New Mexico State Engineer Office, compiler): Santa Fe, N. Mex., State Plan. Office, p. 11–23, illus., tables, 1967.

The Arkansas River basin is drained mostly by the Canadian River and its tributaries; the central and eastern parts are in the Great Plains province and the western edge is in the Southern Rocky Mountain province. Precambrian rocks crop out on the east slope of the Sangre de Cristo Mountains, and Mesozoic rocks along streams and steep hills over most of the area. Precambrian and Pennsylvanian rocks are missing. Tertiary and Quaternary lavas, dikes, and sills are common; unconsolidated deposits are present in buried valleys and flood plains, and commonly cover the large plains. A generalized stratigraphic section gives unit distributions, physical properties, and aquifer characteristics. Analyses from selected wells are tabulated by aquifer.—GDC

06439 **Ballance, W. C.; Titus, Frank B., Jr.** Southern High Plains—Geography, geology, and hydrology, *in* Water resources of New Mexico (New Mexico State Engineer Office, compiler): Santa Fe, N. Mex., State Plan. Office, p. 39–50, illus., tables, 1967.

This area, along the eastern edge of the State, has no permanent streams; its gentle slope is dotted with many broad shallow depressions. Precambrian rocks, at depths considerably below 10,000 feet, are overlain by Ordovician to Permian strata having an aggregate thickness of 14,000 feet but no outcrop. The Triassic Dockum Group and Cretaceous Tucumcari Shale are exposed locally; the Ogallala Formation (Eocene), thinly covered by alluvium, crops out everywhere except in the Portales basin. A generalized section summarizes the distribution, properties, and aquifer characteristics; the best aquifer is the Ogallala. Alluvium in the Portales basin fills the buried valley of an ancient stream that flowed ESE; water in this fill is more highly mineralized.—GDC

Bamber, E. W. *See* Macqueen, R. W. 06102

06213 **Banta, James E.; Hall, Homer K.; Sauer, Herbert I.** Epidemiologic and demographic problems in the study of the geographic relationship of trace elements and the cardiovascular diseases [abs.], *in* Relation of geology and trace elements to nutrition—A symposium, New York, 1963: Geol. Soc. America Spec. Paper 90, p. 6, 1967.

Barker, Richard M. *See* Berry, William B. N. 00354

Barnes, Robert H. *See* Wilson, Charles W., Jr. 06206

00373 **Barnwell, William W.; Boning, Charles W.** Water resources and surficial geology of the Mendenhall Valley, Alaska: U.S. Geol. Survey Hydrol. Inv. Atlas HA–259, scale 1:31,680 and 1:63,360, sections, separate text, 1968.

The map sheet includes insets showing quality of surface and ground waters, Mesozoic and Quaternary formations, aquifers, and paleogeographic maps illustrating sedimentary environment during advance and retreat of glaciers (10,000 B.C. to present); the latter phases (marine, 10,000–4500 B.C.; estuarine and nonmarine, 4500 B.C.–A.D. 1750; nonmarine, A. D. 1750 to present) are described in the text. Ground water is obtained in Recent unconsolidated sediments where wells produce adequate quantities, and in bedrock fractures which supply 1 gpm to 20 gpm; compared to surface water, it is of poor quality, is moderately hard, and contains iron. The Valley was formed by glaciation during the Pleistocene; depositional rates and processes have changed over the past 200–300 years, present regional uplift being calculated at 2 cm per yr.—MCM

05997 **Barry, Thomas L.; Roy, Rustum.** Effective radius of a vacancy, and the calculation of solubility limits in crystals of highly ionic phases of the NaCl structure type [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 70–79, illus., tables, 1967.

An empirical calculation, based on the simplest assumptions of additivity and ideality, has been devised which provides a remarkably accurate and simple way of obtaining the solubility limits in crystals from one lattice-parameter measurement (provided the lattice parameter of the matrix material is previously known). It is effective not only in simple isovalent substitution, but even in those cases where concomitant defects are produced. This treatment has been successfully applied in systems involving a highly ionic *host* (matrix) material (e.g., rare-earth ions in CaO, MgO in CaO, CaO in MgO, and Al_2O_3 in MgO). Its three major applications are: the calculation of solubility limits in crystals; calculation of an "effective radius" for vacancies; and application to the determination of very low solubilities.—Authors' abstract

06158 **Bateman, Paul C.; Eaton, Jerry P.** Sierra Nevada batholith: Science, v. 158, no. 3807, p. 1407–1417, illus., 1967.

The Sierra Nevada batholith is localized in the axis of a complex faulted synclinorium formed in early and middle Mesozoic time in a geosyncline marginal to the continent. There is a downward increase in the proportion of diorite, quartz diorite, and calcic granodiorite relative to quartz monzonite and granite in the upper crust; amphibolite or gabbro–basalt in the lower crust; and peridotite in the upper mantle. Granitic magmas were generated in the lower crust at 25–45 km, mainly by radiogenic heat, at different times in different places as the locus of downfolding shifted; they rose into the upper crust because of density differences. Refractory rocks, unmelted crystals, and early-crystallized mafic minerals that settled from the rising magma thickened the lower crust. Erosion following each magmatic episode has removed 10–12 km of rock since the Jurassic and 7–10 km since early Late Cretaceous.—DBV

06370 **Bathurst, R. G. C.** Subtidal gelatinous mat, sand stabilizer and food, Great Bahama Bank: Jour. Geology, v. 75, no. 6, p. 736–738, 1967.

Calcarenite grains on the Bahama sea floor are bound together by a gelatinous substance to form a coherent mat. The sand is thus immobilized, despite tidal currents strong enough to erode loose grains. The mat contains many and various micro-organisms and is an important source of food for the macrobenthos.—Author's abstract

05980 **Bayne, Charles K.; Schoewe, Walter H.** Geology and ground-water resources of Brown County, Kansas: Kansas Geol. Survey Bull. 186, 68 p., illus., tables, geol. map, 1967.

Rocks that underlie the county, but do not crop out, range from Precambrian to Pennsylvanian; outcropping formations are of Pennsylvanian and Permian age. Pleistocene deposits consist of Kansan glacial till and loess of Wisconsin and Illinoisan(?) ages; Wisconsin and Recent fluvial deposits occur in major valleys. The county lies in the Forest City Basin. Ground water is the principal source of water, and glacial drift is the principal aquifer. The Council Grove Group is an aquifer in the northwest, and Pennsylvanian sandstones yield a little water in the east. The water is hard, but chloride concentrations are high only at depths greater than most wells reach. [A geologic map and cross sections accompany the report. Records of wells and springs are tabulated, and logs of 69 test holes and one well are included.]—*from* Authors' abstract

06298 **Beck, Frederick M.** Maine and New Hampshire—Resources for oceanography, *in* The new thrust seaward—MTS Conf. and Exhibit, 3d Ann., San Diego, Calif., 1967, Trans.: Washington, D. C., Marine Technology Soc., p. 5–9, 1967.

Maine and New Hampshire are well located to participate in a wide variety of oceanographic projects. A large part of the eastern continental shelf is included in the Gulf of Maine and the physical and biological features of this Gulf present unlimited opportunities for use and study. Oceanographic development in this region has not kept pace with growth of the industry in other parts of the country. The principal cause seems to be the lack of academic marine science capability in the region's universities. This problem is being solved with the introduction of marine science programs in the graduate schools of both state universities. The states are cooperating in their oceanographic development through a Bi-State Commission on Oceanography appointed by both governors.—*from* Author's abstract

00310 **Becker, Leroy E.; Patton, John B.** World occurrence of petroleum in pre-Silurian rocks: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 224–245, illus., table, 1968.

This comprehensive review of oil and gas production and potential from pre-Silurian reservoir rocks of North America, Africa, Asia, and Australia indicates a major frontier for petroleum exploration. About 90 percent of the production comes from well-known fields in the midcontinent and southwestern United States, but recent discoveries in Libya, Morocco, and Algeria have achieved significant production; pre-Silurian marine rocks in Asia and Australia are virtually untested. At present, pre-Silurian production of oil and gas constitutes only 3.4 percent of the world production. Rock age itself should be no barrier; the writers believe the petroleum industry has suffered from a "basement complex"—a fear of being in rocks that are too old and too deep—which has inhibited development of pre-Silurian rocks.—BHK

00350 **Becker, Leroy E.** Joseph M. Gorman (1910–1967): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 358–359, portrait, 1968.

06023 **Béland, René.** Saint-Gabriel-de-Brandon area, Joliette, Berthier and Maskinongé Counties [also French edition]: Quebec Dept. Nat. Resources Geol. Rept. 133, 17 p., illus., geol. map, 1967.

The Maskinongé Lake basin, hub of radial drainage, is cut off from the Bayonne River by a long sand and gravel bar anchored on rocky buttresses near Saint Gabriel—apparently a littoral deposit of the maximum Champlain Sea, built from morainic detritus and materials carried along the valley where the present Assomption River dug its channel in a delta plateau or alluvial cone in that Sea. To the north, the Écorces River flows deeply in Precambrian terrane. Bordering crystalline masses, divided by a great fracture, are cut by rectilinear valleys reflecting joint sets. Six Precambrian lithologic units, Grenville gneiss to Saint-Didace granite, overlain by Potsdam sandstone, are described in sequence. Gently dipping contacts parallel foliation of gneisses and granulites. Sand and gravel are the only mineral resource in use. Magnetic anomalies over charnockite granulites reflect a few layers of magnetite.—GDC

06202 **Bellis, William H.; Mankin, Charles J.** Analcime deposits in the Wichita Mountains, southwestern Oklahoma [abs.], *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 191, 1967.

06368 **Belt, Edward S.; Freshney, Edward C.; Read, William A.** Sedimentology of Carboniferous cementstone facies, British Isles and eastern Canada: Jour. Geology, v. 75, no. 6, p. 711–721, illus., 1967.

Distinctive facies of gray and red lutite with interbedded cementstone (calcilutite with 6 to 30 percent siliceous particles) interfinger with fluvial sandstone facies in the Carboniferous fault-block troughs on both sides of the Atlantic Ocean. Repetition of cementstone with lutite suggests salinity and depth changes in the depositional basin; beds of dolomite cementstone were probably deposited as calcitic mud and subsequently altered to dolomite during desiccation. In the Scottish and Irish rift-valley basins, large bodies of saline water were periodically reduced in size and semi-isolated from the sea; in the eastern Canada rift-valley basins, the cementstone facies presumably represent similarly variable bodies of saline water of nonmarine origin.—VES

06083 **Bennett, G.; Riley, R. A.** Operation Lingman Lake, Swan Lake sheet, District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 427, scale 1 in. to 2 mi., 1967.

06084 **Bennett, G.** Operation Lingman Lake, Blackbear River sheet, District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 428, scale 1 in. to 2 mi., 1967.

06085 **Bennett, G.** Operation Lingman Lake, Witegoo River sheet, District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 429, scale 1 in. to 2 mi., 1967.

06086 **Bennett, G.; Riley, R. A.** Operation Lingman Lake, Varveclay Lake sheet, District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 430, scale 1 in. to 2 mi., 1967.

Berens, H. B. *See* Carlson, R. C. 00184

Berg, Joseph W., Jr. *See* Cook, Kenneth L. 06289

Berger, Rainer. *See* Taylor, R. E. 06233

00309 **Berger, Wolfgang H.** Radiolarian skeletons—Solution at depths: Science, v. 159, no. 3820, p. 1237–1239, illus., 1968.

Radiolarian skeletons were placed at several depths on the taut mooring wire of a buoy in the central Pacific for four months. Recent radiolarian sediment dissolved at appreciable rates at depths shallower than 2,000 m; solution was greatest near the surface and decreased with depth. This pattern correlates with bathymetric distributions of dissolved silicon and of temperature. Siliceous Radiolaria from planktonic samples appeared to dissolve about eight times faster than those from sediment. Tripyleans seemed to be less resistant than polycystins. Acantharia dissolved completely at all depths.—Author's abstract

06393 **Bernal, J. D.** The origin of life: Cleveland, Ohio, and New York, World Publishing Co., 345 p., illus., tables, 1967.

The book contains 10 chapters: an introduction to creation and evolution, notions of the origins of life in the past, modern views on the origin of life, the origin of biological monomers, stage two of biopoesis and origin of biological polymers, from molecule to cell, the origin of life in time and space, alternative pathways to biopoesis, outstanding difficulties in accounts of the origin of life, and the influence on contemporary thought of the discussions on the origin of life. Appendix 1 contains two papers on the origin of life by A. I. Oparin and J. B. S. Haldane which are cited separately, and discussions by Bernal. Appendix 2, on carbonaceous

meteorites, by G. Mueller, is cited separately also. Appendix 3 covers generalized crystallography, and 4 contains questions and answers. An extensive glossary is included.—ESL

Bernas, René. *See* Gradsztajn, Eli. 00212

00354 **Berry, William B. N.; Barker, Richard M.** Fossil bivalve shells indicate longer month and year in Cretaceous than present: Nature, v. 217, no. 5132, p. 938–939, 1968.

Data for living species suggest a relationship between shell growth increments and tidal cycles in at least some bivalves. Cretaceous shells from several North American localities have been examined in order to determine whether these influences are discernible. It is found that there are 24.98 fortnightly cycles in the Late Cretaceous year, or 12.49 lunar months, with 29.65 days in the month compared with 29.53 at present. This gives a Late Cretaceous year of 370.3 days, in close agreement with the 371 days estimated from astronomical data. These results support Wells' (1963) suggestion that the study of fossils may provide a third line of evidence to geophysical and astronomical estimates of the age and history of the Earth.—DBV

Bevan, Jacqueline M. *See* Davies, David K. 06410

Biemann, K. *See* Hayes, J. M. 00295

06176 **Bisal, Frederick; Nielsen, Kenneth F.** Effect of frost action on the size of soil aggregates: Soil Sci., v. 104, no. 4, p. 268–272, tables, 1967.

There is little effect of frost on the aggregate size distribution in clay or fine sandy loam. Frost action decreased the percentage of erodible particles in a loam soil. Freezing and thawing decreased the percentage of erodible particles in the clay, loam, and fine sandy loam soil at higher moisture levels. There is essentially no difference in the water-stable aggregates because of freezing and thawing.—JWH

00277 **Bischoff, J. L.; Fyfe, W. S.** Catalysis, inhibition, and the calcite-aragonite problem—[Pt.] 1, The aragonite-calcite transformation: Am. Jour. Sci., v. 266, no. 2, p. 65–79, illus., 1968.

The kinetics of the aragonite–calcite transformation were studied in aqueous solution to determine the factors involved in the process of calcite crystallization and the controlling diagenetic conditions for the aragonite–calcite transformation. The reaction involved the solution and equilibration of aragonite with the solution and the subsequent nucleation and growth of calcite. The extent of reaction was determined by X-ray diffraction. Data suggest that calcite nucleation occurs on aragonite surface, whereas growth occurs on point or line defects. Catalysis by CO_2, $CaCl_2$, and inhibition by KOH indicate a fundamental reaction involving Ca^{++} and HCO_3^-. Calcite crystallization is strongly inhibited by Mg^{++} and less so by SO_4^{--}.—Authors' abstract

00278 **Bischoff, J. L.** Catalysis, inhibition, and the calcite-aragonite problem—[Pt.] 2, The vaterite-aragonite transformation: Am. Jour. Sci., v. 266, no. 2, p. 80–90, illus., 1968.

The kinetics of the vaterite–aragonite transformation in aqueous solution were studied to determine the factors involved in aragonite formation. The reaction involved the solution and equilibration of vaterite and subsequent nucleation and growth of aragonite. Extent of reaction was monitored by time-lapse photography. The effect of various geologically common ions was studied. Sulfate is a strong inhibitor of aragonite formation, while magnesium is weakly so. Strontium catalizes aragonite formation in solutions in which strontianite is supersaturated. Ionic strength catalizes aragonite formation. The predominance of either aragonite or calcite in natural environments is determined primarily by magnesium ion content.—*from* Author's abstract

06115 **Bittinger, M. W.; Duke, H. R.; Longenbaugh, R. A.** Mathematical simulations for better aquifer management [with French abs.], *in* Artificial recharge and

management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 509–519, illus., 1967.

Manipulation of groundwater storage in conjunction with surface water supplies often requires simultaneous consideration of varied aquifer hydraulic and geometric characteristics, highly variable pumping patterns in time and space, imperfectly connected bodies of surface water and non-deterministic natural recharge. In addition, legal, economic and social conditions impose constraints which must be considered in aquifer operation and management. This paper describes mathematical modeling and computer analysis techniques that allow consideration of the many varied and changing factors mentioned above. Application is made to specific aquifer management problems.—Authors' abstract

Bittinger, M. W. *See* Maasland, D. E. L. 06134

00377 **Bivins, Doris; Ergun, Sabri.** Magnetic susceptibilities of coals: Science, v. 159, no. 3810, p. 83, table, 1968.

Magnetic susceptibilities are reported for seven American coals of different rank. The susceptibilities were measured in magnetic fields parallel and perpendicular to the bedding planes. The coals have diamagnetic susceptibilities approximating 0.5×10^{-6} cm-gm-sec unit. Only anthracite shows significant magnetic anisotropy.—Authors' abstract

06444 **Bixby, William.** Seawatchers—Oceanographers in action: New York, David McKay Co., 215 p., illus., table, 1967.

This account for the nonscientific reader follows a voyage of the *Chain* from Woods Hole, Mass., to Bermuda. Chapter headings are: waters of the sea (includes origin of Earth and oceans), Earth beneath the sea (floor on shelf, slope, and basin, life and methods used to study them), eternal waves, profile of the sea, life in the sea, food from the sea, wealth of the sea (dredging the ocean bottom, manganese nodules, dissolved metallic elements, mining operations, oil and gas drilling), sea technology, and famous oceanographers and voyagers.—ESL

06224 **Black, Herbert L.; Haarr, Allan P.** (editors). 1965 Speleo Digest—A collection of speleological writings taken from the publications of the Chapters of the National Speleological Society: Vienna, Va., Speleo Digest Press, [436] p., illus., 1967.

The volume is divided into four sections, paged separately, and has author and subject indexes. The first section contains cave descriptions, grouped alphabetically by state. Cave science, the second section, includes cave features, genesis, age, types, mineralogy, biota, and history. The third section contains articles on technique and equipment. The last section is devoted to humor.—ESL

06127 **Black, Michael.** Arctic lupins bloom after 10,000 years: New Scientist, v. 36, no. 567, p. 148–149, illus., 1967.

Germination of seeds of *Lupinus arcticus* at least 10,000 years old, found in lemming burrows in permanently frozen Pleistocene silt in central Yukon, has been reported by Porsild, Harington, and Mulligan (Science, v. 158, no. 3797, p. 113–114, 1967). Previous records of seed viability have not exceeded 1,700 years. These records are reviewed in the light of seed metabolism, permeability of seed coats, temperature and moisture conditions of the environment, and findings of long-term experiments.—VMJ

06020 **Blake, Martha A.** (compiler). Bibliography of vertebrate paleontology and related subjects, 1965–1966: Soc. Vertebrate Paleontology Bibliography 21, 82 p., 1967.

05986 **Blatt, Harvey.** Diagenesis of sandstones—Processes and problems, *in* Symposium on recently developed geologic principles and sedimentation of the Permo-Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf., Casper, 1966: Casper, Wyo., Petroleum Inf., p. 63–65, illus. [1967?].

The most important processes affecting porosity of sandstones are compaction and cementation. Packing of an undeformed sandstone depends on: (1) mode of deposition, (2) grain size, (3) grain shape, (4) sorting, (5) presence of clay matrix, (6) mineralogic composition, (7) overburden pressure, and (8) time of chemical cement precipitation. Thin section studies of sandstone cementation show: (1) silica, calcite and dolomite are the most abundant chemical compounds; (2) presence and type of chemical cement may vary with time; (3) amount of chemical cement is negatively correlated with the amount of detrital material. Since natural waters are usually undersaturated with respect to opal but supersaturated with respect to quartz, some quartz cement may form without addition of silica to underground waters.—KAS

06451 **Blattner, S. D.** Exploration in the Gulf of Mexico [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 793–798, illus., 1967.

Exploration in the Gulf of Mexico started in 1938 as an extension of operations on land. By 1966, 7,500 wells had been drilled, resulting in reserves of approximately 2.2 billion bbl of oil and 2.7 trillion cu ft of gas. Industry had approximately 58 mobile drilling rigs, 24 seismic crews, and 900 geologists and geophysicists engaged in exploration in the Gulf. Modern developments in geology, geophysics, and drilling will enable the explorationist to locate major hydrocarbon deposits wherever they may exist in the Gulf of Mexico.—*from* Author's abstract

06173 **Blench, T.** Inductive approach to phases of mobile-bed roughness [with French abs.], Paper A3 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1, River hydraulics: Fort Collins, Colo., Colorado State Univ., p. 18–26, illus.; discussion, ibid., V. 5, p. 23, 1967.

The status of "evolution of the river bed" and "sediment transport" in the IHD Program is discussed. A major weakness in the combined topics is seen to be the gross discordance among competitive bed-load transport formulas, which are flow formulas expressed with the bed-load transport explicit in the roughness factor. Discordances are believed to arise from reliance on deduction from speculative premises to the exclusion of physical considerations. An inductive attack on the formula problem is outlined, with explanations. An orientation of research is proposed to suit.—Author's abstract

06235 **Blesch, Robert R.** Mapa geológico preliminar con información del agua subterránea y datos mineralógicos, República Dominicana: Washington, D.C., Organización de los Estados Americanos, scale 1:250,000, 1967

06383 **Bluemle, John P.** Popular geology of Eddy and Foster Counties, North Dakota: North Dakota Geol. Survey Misc. Ser. 31, 20 p., illus., geol. map, 1967.

Intended for high school teachers, students, farmers, and others who might be interested in the area in which they live and work, this book is based on one of a series of North Dakota Geological Survey bulletins that deals with the geology and water resources of the various counties of the state. Some important general concepts are discussed briefly, and a fairly detailed look is given Eddy and Foster Counties. Generalized maps of surface geology and ground-water availability, and road logs are included.—GDC

06372 **Blyth, Colin R.; Graf, Donald L.; Stemmler, Rosemarie S.** Mixed-layer models with second-layer dependence: Jour. Geology, v. 75, no. 6, p. 743–746, 1967.

A succession of packets (multiple layers) characterized in terms of a two-packet Markov-2 model can be redefined in terms of a four-packet Markov-1 model by specifying the relative abundance of the two kinds of packets together with the transition probabilities $p_{11\,1}$, $p_{21\,1}$ and $p_{22\,1}$. The diffracted X-ray intensity expectable from interlayered basal sequences of rhombohedral calcium and magnesium carbonates is considered as an example. The models are also broadly applicable to studies of rhythmic bedding.—Authors' abstract

00314 **Bogard, D.; Burnett, D.; Eberhardt, P.; Wasserburg, G. J.** ^{40}Ar–^{40}K ages of silicate inclusions in iron meteorites: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 275–283, tables, 1967 [1968].

Analyses were made on Weekeroo Station, Toluca, Four Corners, and Kodaikanal meteorites. The K–40/Ar–40 ratios of all samples except Kodaikanal are compatible with an age of $4.5\pm0.15\times10^9$ yr. These are in agreement with the Sr–Rb results obtained previously but not with the so–called K–40/Ar–40 ages determined on iron meteorites by other workers. The K–40/Ar–40 age of Kodaikanal ($3.5\pm0.1\times10^9$ yr) is consistent with the Rb–87/Sr–87 age of $3.8\pm0.1\times10^9$ yr. Estimates of the U+Th content of the silicate inclusions were made based upon the He–4 contents. Kodaikanal is young for an iron meteorite ($\leq$40 m.y.) based upon upper limits to the cosmogenic He, Ne, and Ar in the metal phase.—*from* Authors' abstract

06321 **Boldt, Joseph R., Jr.** The geology of nickel, Sec. 1; Mining for nickel, Sec. 2, *in* The winning of nickel—Its geology, mining, and extractive mineralogy: Princeton, N.J., D. Van Nostrand Co., p. 1–187, 457–461, illus., tables, 1967.

The universal abundance of nickel is contrasted with a scant 0.008 percent in the Earth's crust. Usually associated with ultramafic rocks rich in iron and magnesium, the nickel–bearing minerals are listed and described briefly. Sulfide ores are compared with lateritic ores. Geologic descriptions include deposits in Canada, United States, and the Caribbean region. Section 2 reviews the relatively modern history of nickel exploration and mining, and the different techniques used. The 65–year development of the Creighton mine in Ontario's Sudbury basin, and more recent Manitoba mines, show how methods are adapted to varying conditions. Lateritic mines are examined in Cuba, Oregon, and New Caledonia. The latter's story ranges from primitive workings of a century ago to recent extensive mechanization.—GDC

06311 **Bolt, G. H.** A reconsideration of the Shainberg and Kemper paper ["Ion exchange equilibria on montmorillonite", 1967]: Soil Sci., v. 104, no. 6, p. 444–448, 450–451, illus., table, 1967.

Using a complete form of the Stern equation, the Shainberg–Kemper approach for the calculation of selectivity coefficients for homovalent exchange was amended to improve its internal inconsistency. The present and original approach are compared numerically. [Bolt further supports the use of the cubic conservation equation, although hesitantly, in rebuttal to Shainberg and Kemper's reply to his discussion.]—Author's summary

06400 **Bonham–Carter, G. F.** An example of the analysis of semi–quantitative petrographic data [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 567–583, illus., tables, 1967.

This study illustrates application of a numerical method of classifying limestones where semi–quantitative data are available. Nineteen petrographic variables were measured, using a coarse ordinal scale, from systematic samples of Tellevak Limestone, Ellesmere Island, Canada. Multivariate classification by cluster analysis, employing Jaccard's coefficient of association and the unweighted pair–group method, was used to group samples into ten sedimentary facies; tabulated frequency data illustrated composition of each facies; chi–square values calculated from contingency tables measured the importance of each attribute to the classification. Distribution of facies was studied graphically on a stratigraphic cross section and by using Spearman's rank correlation coefficients. Results indicate that the Tellevak Limestone is a back–reef deposit with a progressively more restricted environment from NE to SW.—*from* Author's abstract

Boning, Charles W. *See* Barnwell, William W. 00373

Borcsik, Maria. *See* Gammon, J. B. 06396

Borns, Harold W., Jr. *See* Swift, Donald J. P. 06367

06398 **Boulware, Robert A.** Seismic exploration for stratigraphic traps in Canada [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 471–479, illus., 1967.

Various techniques for detecting reefs in reflection seismic records and some nonreefal traps (pinchouts) are discussed briefly; included are the drape effect, the velocity anomaly effect, noncontinuous or segmented reflections, reflection amplitude analysis, and unconformities associated with underlying reefs. Most of these involve the study of reflection character, for which synthetic seismograms constructed from continuous and velocity logs have been helpful. Analysis of amplitude ratios has been of aid in predicting the thickness as well as the presence of sands. Pinchouts directly visible on the logs are discussed, and examples shown. In the future, the search for stratigraphic traps is expected to be aided by computer processing, controlled frequency input signal systems, and improved instruments.—KAR

06130 **Bouwer, Herman.** Field measurement of saturated hydraulic conductivity in initially unsaturated soil [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 243–251, illus., 1967.

Recent developments for measuring vertical hydraulic conductivity, K, in the zone between soil surface and water table include: seepage meters suitable for measuring K of bottom material, local infiltration rates, and gradients in spreading basins; and a new permeameter-type device enabling rapid field measurement of K and the negative soil-water pressures whereby it undergoes its first reduction. The method is applicable to surface and subsurface soil layers and data are obtained for sorption as well as desorption. Relatively deep K-measurements can be made by determining infiltration rates and gradients at the bottom of auger holes and wells; fast-reacting piezometers were developed for this purpose. A brief discussion of how K-data can be used in analytical, analog, or digital models for predicting total flow systems below spreading basins is included.—*from* Author's abstract

06179 **Bouyoucos, George J.; Cook, Ray L.** Measuring the relative humidity of soils at different moisture contents by the gray hydrocal hygrometer: Soil Sci., v. 104, no. 4, p. 297–305, illus., tables, 1967.

Experimental results show that the relationship between relative humidity and the amount of water the sensor adsorbs, as measured by its electrical resistance, is remarkably accurate, sensitive, and consistent; this is true even at the highest relative humidity. The sensor is highly sensitive to humidity changes.—JWH

Bowin, Carl O. *See* VanAndel, Tjeerd H. 00286

Bowler, Russell A. *See* Peters, John C. 00301

00179 **Bowles, Frederick A.** Microstructure of sediments—Investigation with ultrathin sections: Science, v. 159, no. 3820, p. 1236–1237, illus., table, 1968.

Examination of ultrathin sections of "undisturbed" marine sediments from the Gulf of Mexico indicates that they are characterized by a loose, open, random arrangement of particles. The microstructures do not appear to conform entirely to either cardhouse or honeycomb structures.—Author's abstract

06284 **Boyle, R. W.** Regularities in wallrock alteration phenomena associated with epigenetic mineral deposits—A review [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B221, 1967.

06285 **Boyle, R. W.** Source of metals and gangue elements in hydrothermal deposits [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B221, 1967.

06295 **Brabb, Earl E.** Chittenden, California, earthquake of September 14, 1963, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 91, p. 45–53, illus., table, 1967.

An earthquake of magnitude 5.2 on the Richter scale occurred at 19:46 GCT September 14, 1963, in the Monterey Bay region of west-central California. The damage to structures and the eyewitness accounts indicate that the maximum intensity of VII on the modified Mercalli scale occurred at Chittenden, Santa Cruz County, Calif., and that the earthquake was associated with movement along the San Andreas fault. Apparent errors in locating the epicenter by computer methods were as large as 30 kilometers. Geologic effects from the earthquake included landslides along oversteepened road and quarry cuts and an increase in spring flow. No evidence of surface rupture along the San Andreas fault was found.—Author's abstract

00279 **Brace, W. F.; Orange, A. S.** Electrical resistivity changes in saturated rocks during fracture and frictional sliding: Jour. Geophys. Research, v. 73, no. 4, p. 1433–1445, illus., table, 1968.

Changes in electrical resistivity were observed as a function of compressive stress in a variety of crystalline rocks subjected to confining pressure of up to 5 kb and to a pore pressure of 500 bars. In the majority, resistivity increased slightly up to about half the fracture stress. A sharp decrease in resistivity of an order of magnitude within about 20 percent of the fracture stress corresponded closely to an increase in porosity which took place under compressive stress. Detailed study of Westerly granite suggests that fracture occurred at a critical crack porosity that was pressure independent. The changes in resistivity with stress that accompany frictional sliding on a fault are insignificant when the measurement volume contains the fault, even though faulted rock under pressure can support high stress.—*from* Authors' abstract

06268 **Bradley, Howard B.** (compiler). General index to publications of the Society of Petroleum Engineers of AIME (1953–1966): Dallas, Tex., Soc. Petroleum Engineers AIME, 320 p., 1967.

This is the second volume of the general index to Transactions of the Society of Petroleum Engineers of AIME, the Journal of Petroleum Technology, and the Society of Petroleum Engineers Journal. The index is compiled by authors' names and by subject in a single composite alphabetical listing.—MCM

Bradley, W. F. *See* Deeds, C. T. 06223

06258 **Bradley, W. H.** Precursors of oil shale [with French and Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 695–697, illus., table, 1967.

Four modern lakes have been found that produce organic ooze analogous to the inferred precursor of the organic matter in Eocene oil shale. One meter of this ooze accumulated in about 2,200 years. The ooze consists of blue-green algae and is in the form of minute fecal pellets. It contains few, and strange, bacteria and is remarkably resistant to decay. It contains a large percentage of lignin and minute amounts of fatty acids and hydrocarbons. Research to identify the organic compounds and biochemical processes is under way.—Author's abstract

Breiner, Sheldon. *See* Hirshberg, Joan. 00203

00178 **Bretsky, Peter W.** Evolution of Paleozoic marine invertebrate communities: Science, v. 159, no. 3820, p. 1231–1233, illus., table, 1968.

Communities of Paleozoic shelf invertebrates underwent varied rates of change in faunal composition. Notable changes took place during Late Devonian–Early Mississippian time and were most noticeable in offshore brachiopod-dominated communities. Near-shore molluscan communities remained relatively stable throughout the Paleozoic.—Author's abstract

06300 **Briggs, Robert O.; Shipek, Carl.** Development of a new instrument for measuring ocean bottom micro profile relief, *in* The new thrust seaward—MTS Conf. and Exhibit, 3d Ann., San Diego, Calif., 1967, Trans.: Washington, D. C., Marine Technology Soc., p. 61–72, illus., 1967.

Geologists and scientists interested in underwater sound reflection from the ocean bottom have been applying stereophotography and photogrammetric techniques to measure microroughness of the ocean floor. Obtaining stereophotos of representative deep environments is expensive, requiring use of stereophotographic cameras, preferably with water-corrected lenses in a system demanding high geometric precision; data obtained is usually reduced using manually operated stereo film reading devices. A new technique for obtaining and measuring ocean bottom microprofiles simplifies the measuring and recording system by permitting use of a single still or TV camera rather than stereopairs and simplifies the data reduction process allowing data to be obtained from a single photograph with a pair of dividers and a ruler.—*from* Authors' abstract

Brindley, G. W. *See* Mering, J. 06122

06186 **Brindley, G. W.** Clay mineral nomenclature (Report of discussions and recommendations of The Clay Minerals Society Nomenclature Committee), *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 437–440, 1967.

Discussions and recommendations of The Clay Minerals Society, Nomenclature Committee, 1965–66, are summarized.—Author's abstract

00211 **Broecker, Wallace S.; Thurber, David L.; Goddard, John; Ku, Teh-Lung; Matthews, R. K.; Mesolella, Kenneth J.** Milankovitch hypothesis supported by precise dating of coral reefs and deep-sea sediments: Science, v. 159, no. 3812, p. 297–300, illus., tables, 1968.

Barbados provides a possibly unique opportunity for reconstruction of the times and elevations of late-Pleistocene high stands of the sea. The island appears to be rising from the sea at a uniform rate that is fast enough to separate in elevation coral-reef tracts formed at successive high stands of the sea. Unaltered coral found in the lower terraces enables high-precision Th-230/U-234 and Pa-231/U-235 dating. Three distinct high stands of the sea are found at about 122,000, 103,000, and 82,000 years ago. New Pa-231 and Th-230 dates from a deep-sea core also indicate that Ericson's W-X cold-to-warm climatic change occurred close to 126,000 years ago. These data show a parallelism over the last 150,000 years between changes in Earth's climate and changes in the summer insolation predicted from cycles in the tilt and precession of Earth's axis.—Authors' abstract

Broecker, Wallace S. *See* Taddeucci, Adriano, 00315

06232 **Broecker, Wallace S.; Li, Yuan Hui; Cromwell, John.** Radium-226 and radon-222—Concentrations in Atlantic and Pacific Oceans: Science, v. 158, no. 3806, p. 1307–1311, illus., tables, 1967.

Measurements of radon-222 in Atlantic and Pacific seawater show that the Ra-226 content of surface water in both oceans is about 4×10^{-14} g per l, and the Ra-226 concentration in the deep Pacific is four times higher, and in the deep Atlantic twice as high, compared to surface concentration. This distribution can be explained by the same particle-settling rate for Ra-226 and threefold longer residence time of water in the deep Pacific than in the deep Atlantic. The vertical distribution of Rn-222 deficiency in northwest Pacific surface water suggests a coefficient of vertical eddy diffusion of 120 sq cm per sec and a gas-exchange rate for CO_2 in surface water between 14 and 60 moles per sq m per yr. Vertical profiles of excess Rn-222 in South Atlantic near-bottom water give coefficients of vertical eddy diffusion of 1.5 to 50 sq cm per sec or more.—DBV

00358 **Broughton, Paul L.** Peanut obsidian from Sonora, Mexico: Jour. Gemmology, v. 11, no. 1, p. 7–9, illus., 1968.

Popularly called *peanut obsidian*, this black glass, discovered near Alamos, contains in nearly half its volume quarter-inch red spherules. A cabochon-cut is similar in effect to bloodstone in reverse. Thin sections show the perlitic structure; spherulites are thin rod-like, radiating crystals of feldspar, stained by hematite;

secondary chalcedony appears to encase each spherulite and fill cracks. X-ray diffraction verified interstitial crystobalite, as well as feldspar near oligoclase in composition. Near the original outcrop an agatized variety was discovered later, its matrix earthy gray in color and spherules up to two inches across in concentric red, gray, white and brown layers. Another variety, with porcelain-like matrix and quarter-inch spherulites is altered to bentonite and too soft for most lapidary use.—GDC

Brown, G. M. *See* Wager, L. R. 00366

06237 **Brown, G. M.** Mineralogy of basaltic rocks, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 103–162, illus., tables, 1967.

In a basaltic magma, the composition of the first plagioclase to crystallize is An_{85-90}, that of the first olivine about Fo_{90}. The pyroxenes crystallize in two series, Ca-poor (bronzite-pigeonite) and Ca-rich (augite-ferroaugite). Fractionation trends are discussed with particular reference to pyroxene, which is considered the most important mineral group for understanding the derivation of, and distinctions between, basaltic magmas. The best optical methods for determining the composition of plagioclase and olivine are refractive index and 2V determinations. In the plagioclases, this is complicated by effects due to different structural states, which in basalts are mainly of intermediate or transitional anorthite types. A brief review of minor mineral constituents is included also.—AGM

00198 **Brown, R. L.** Earthquake considerations in earth dam design—Discussion [of paper 5322 by James L. Sherard, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 5827, Jour. Soil Mechanics and Found. Div., no. SM2, p. 600–602, 1968.

Results of Sherard's study [ibid., v. 93, no. SM4, p. 377–401, 1967] are extremely valuable. The total time in which a reservoir may remain a hazard must be considered in relation to the time scale of tectonic activity. It is better to postulate a general wave form from a shock and its modification with distance than to design for a nearby earthquake generating high ground acceleration. The concept of sufficient safety is useful and can lead to optimum design. Warning of deterioration of an earth dam can be furnished by correct instrumentation during construction. Instrumentation of dams in seismically active areas gives information useful in refining design information.—ESL

06001 **Brown, Sally Liggett.** Stratigraphy and depositional environment of the Elgin sandstone (Pennsylvanian) in south-central Kansas: Kansas Geol. Survey Bull. 187, pt. 3, 9 p., illus., table, 1967.

The Elgin sandstone, a unit in the Kanwaka Shale (Virgilian, Upper Pennsylvanian), crops out in south-central Kansas. Distribution of the Elgin, which ranges from 0 to 180 feet in thickness, indicates that it was deposited in a shallow-marine to marginal-marine environment controlled by the distributary pattern of a large delta complex. Major source of the material for the clastic wedge was from the south in the Arbuckle-Ouachita Mountain area. Distribution of the Elgin sandstone seemingly was not influenced by the algal limestone buildups of the underlying Plattsmouth Limestone Member of the Oread Limestone, although the basal shales of the Kanwaka reflect the presence of these buildups. [Isopach maps and cross sections accompany the report.]—Author's abstract

Brown, W. L. *See* Grundy, H. D. 06094

00260 **Bryant, Vaughn M., Jr.; Holz, Robert K.** The role of pollen in the reconstruction of past environments: Pennsylvania Geographer, v. 6, no. 1, p. 11–19, illus., 1968.

Through careful and detailed study, palynologists are able to reconstruct many aspects of past vegetations and so obtain a key to past climatic conditions. This paper documents the construction of a pollen diagram, points out some of the strengths and limitations of pollen analysis, discusses methods of collecting pollen samples, and shows how analysis can be applied in solving problems relating to paleoenvironmental reconstruction, particularly as it relates to prehistory.—ESL

Brydon, J. E. *See* Turner, R. C. 06183

06246 **Bucher, Walter H.** Memorial to Arie Poldervaart (1918–1964), *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. vi–xiii, portrait, 1967.

05984 **Buerger, M. J.; Dollase, W. A.; Garaycochea-Wittke, Isabel.** The structure and composition of the mineral pharmacosiderite [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 92–108, illus., tables, 1967.

The structure of Cornwall pharmacosiderite proposed by Zemann (1947) was reinvestigated. Weaker reflections require a larger cell and, with weak birefringence, indicate lower symmetry. The structure was confined to $R = 6\ 1/2$ percent, which confirms Zemann's framework but modifies filling of open spaces in which no alkali atoms are present. If structure is referred to an isometric cell with $a = 7.98$ A, water molecules occupy only the partially equivalent positions assigned them. It is concluded that in true pharmacosiderite structure, the framework is continuous but water which fills its cavities degrades the symmetry, and what appears to be an individual crystal is actually composed of regions in which arrangement of water molecules is uniform; arrangements of molecules in adjacent regions are in twinned orientation.—*from* Authors' abstract

06305 **Burg, K. E.** Low frequency acoustic sources for marine application, *in* The new thrust seaward—MTS Conf. and Exhibit, 3d Ann., San Diego, Calif., 1967, Trans.: Washington, D. C., Marine Technology Soc., p. 185–200, illus., 1967.

The need for low frequency acoustic sources for offshore seismic exploration has led to the development of a number of different types. Power spectra analysis of pulse measurements describing various sources shows a wide range of characteristics. An impulsive source has a frequency spectra flat to one thousand Hz. A gas gun type is rich in frequencies as low as seven Hz. The frequency and peak pressure of the pneumatic source can be varied from four to fifty Hz. Continuous frequency sources generate a ramp or chirp signal with frequencies continuously varying from ten to one hundred Hz. Peak pressures range as high as 140 db above one microbar at one yard. These various acoustic sources are replacing high explosives as a source of seismic energy for offshore exploration because they cost less, and are simpler in operation and more adaptable to digital data recording and processing techniques.—*from* Author's abstract

Burgy, Robert H. *See* Kriz, George J. 00268

00267 **Burke, Kevin.** Drowned dwarf atolls south of Jamaica: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 348–350, illus., 1968.

The small banks south of Jamaica may have formed as coral-algal reefs that built up during intermittent subsidence of the mid-Miocene surface.—WCC

Burnett, D. *See* Bogard, D. 00314

05991 **Burnham, Charles W.; Clark, Joan R.; Papike, J. J.; Prewitt, C. T.** A proposed crystallographic nomenclature for clinopyroxene structures [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 109–119, illus., tables, 1967.

In order to facilitate comparison of clinopyroxene structural data, a uniform crystallographic nomenclature applicable to all clinopyroxenes having structures similar to that of diopside is proposed and illustrated.—Authors' abstract

Burnham, Charles W. *See* Güven, Necip. 05993

06363 **Butler, Arthur P., Jr.** Uranium reserves and progress in exploration and development: U.S. Geol. Survey Circ. 547, 8 p., illus., 1967.

Uranium needed to fuel reactors ordered in the future will have to come largely from deposits yet to be discovered. Distribution of known deposits indicates that

these are likely to occur in continental sandstones, unexplored areas of which are large in relation to the partly explored areas containing known deposits. Less intensely mineralized strata of greater extent offer less clearly defined possibilities. Knowledge about uranium deposits is more broadly based than it was 20 years ago, and possibilities are good that with intensive exploration the search will be successful. Technology in the use of uranium is certain to improve.—ESL

00169 **Buzas, Martin A.** Foraminifera from the Hadley Harbor Complex, Massachusetts: Smithsonian Misc. Colln., v. 152, no. 8 (Pub. 4727), 26 p., illus., tables, 1968.

The distribution, density, and environmental relationships of Foraminifera from 272 stations are analyzed. Channels, an inner harbor, and an outer harbor area are recognized. Sediments in the channels are coarser than in the harbors, and currents are stronger. Silt and clay is deposited in the inner harbor and sandy silt in the outer harbor (more wave action). The Foraminifera content and their controls are described. Salinity and pH were everywhere constant; Eh varied considerably, as did light penetration in the turbid water. The Shannon–Weiner information function was used to recognize diversity. There was no simple relationship between fauna and distribution.—HRC

06322 **Cadman, John D.; Goodman, Richard E.** Landslide noise: Science, v. 158, no. 3805, p. 1182–1184, illus., 1967.

Acoustical monitoring of real landslides has revealed the existence of subaudible noise activity prior to failure and has enabled prediction of the depth of the seat of sliding when conducted in boreholes beneath the surface. Recordings of noise generated in small slopes of moist sand, tilted to failure in laboratory tests, have been analyzed to determine the foci of discrete subaudible noise events. The noises emitted shortly before failure were plotted close to the true sliding surface observed after failure. The foci of earlier events lay either within the central portion of the sliding mass or in a region behind the failure surface. The head and toe zones were devoid of strong seismic activity.—Authors' abstract

06292 **Cagle, J. W.; Steinhilber, W. L.** Availability of ground water in Decatur County, Iowa: Iowa Geol. Survey Water Atlas 2, 28 p., illus., tables, 1967.

Decatur County is one of several beset with water-supply problems. Small-to-moderate quantities of hard water are available from unconsolidated deposits: alluvium of major river valleys yields 10 to 50 gpm per well, glacial drift 3 to 10 gpm, and elsewhere less than 1 gpm. Bedrock, Cambrian to Pennsylvanian in age, yields moderate-to-large supplies of highly mineralized and poor quality water: several hundred gpm per well from depths of 2,600 to 2,700 feet, but with objectionable chloride, and 80 to 100 gpm, with objectionable sulfate, from shallower strata. Water from bedrock may satisfy most industrial needs, but municipal supplies must be treated. Water from alluvium and some glacial drift is probably satisfactory for rural needs. Well data are tabulated.—GDC

Caldwell, Dabney W. *See* Overstreet, William C. 00323

06069 **Calvin, Melvin.** Chemical evolution of life on Earth, *in* The Earth in space (Hugh Odishaw, editor): New York and London, Basic Books, p. 285–296, 1967.

This is a popular account of the inorganic background of the origin of organic life. All of the necessary components of life occur inorganically as a part of the Earth; the combination necessary to result in life could have developed over the span of geological time. The theory and technique of identifying organic substances in rocks is described. Rocks 2.5 b.y. old contain significant organic residues. The oldest known rocks (3.3 b.y.) contain a small amount of organic matter. Details of the biochemistry of living cells are included also.—HRC

06265 **Campbell, C. A.; Paul, E. A.; Rennie, D. A.; McCallum, K. J.** Applicability of the carbon-dating method of analysis to soil humus studies: Soil Sci., v. 104, no. 3, p. 217–224, illus., tables, 1967.

The natural C–14 activity of the organic matter fractions suggests that the humus was much more stable than the mobile humic acids and the latter more resistant to decomposition than the fulvic acids. Humic fractions of the podzolic gray wooded soil were less stable than their chernozemic counterparts. It is concluded that the carbon dating method supported by other chemical methods of analysis is a useful research procedure in soil organic matter investigations.—JWH

06141 **Campbell, Charles V.** Lamina, laminaset, bed and bedset: Sedimentology, v. 8, no. 1, p. 7–26, illus., table, 1967.

From the smallest to the largest, the component layers of a sedimentary body are laminae, laminasets, beds, and bedsets. Different arrangements of these characterize different types of sedimentary bodies and processes. Concepts are redefined. The four are genetically similar, and when compared with each other differ principally in areal extent and interval of time for formation; they are considered the "basic building blocks" of sedimentary bodies. Beds are bounded by depositional surfaces which are considered practically synchronous. A bed is an informal time stratigraphic unit, hence more refined basinal correlation is possible. Better recognition of the mode of genesis and distinguishing characters of different types of sedimentary bodies are also possible.—*from* Author's summary

Campbell, J. A. *See* Baars, D. L. 00181

06139 **Campbell, K. S. W.** Trilobites of the Henryhouse Formation (Silurian) in Oklahoma: Oklahoma Geol. Survey Bull. 115, 68 p., illus., tables, 1967.

Eleven species in ten genera are described. *Anasobella* and *Ananaspis* are new, as are ten of the species. The fauna is peculiar in that it lacks illaenids and lichids. Some members of the Phacopinae and Phacopidellinae are discussed, and *Phacops, Reedops, and Eophacops* are redefined. *Acernaspis*, new genus, is erected from *Phacops orestes*. A phylogeny for Silurian to Middle Devonian phacopinids and phacopinellinids is outlined. The fauna is unusually well preserved and great detail is available. The age of the fauna is late Wenlockian to early Ludlovian, and elements of the faunas of Bohemia, Great Britain, and the northeastern United States are present.—*from* Author's abstract

06307 **Campbell, R. B.** Geology, Glenlyon map-area, Yukon Territory: Canada Geol. Survey Map 1221A (also in Mem. 352), scale 1:253,440, 1967.

06317 **Campbell, R. B.** Surficial geology, Glenlyon, Yukon Territory: Canada Geol. Survey Map 1222A (also in Mem. 352), scale 1:253,440, 1967.

06319 **Campbell, R. B.** Geology of Glenlyon map-area, Yukon Territory [with French abs.]: Canada Geol. Survey Mem. 352, 92 p., illus., table, geol. maps, 1967.

The map-area lies on the Yukon Plateau; deep dissection of the old surface suggests uplift. Glaciation was studied with airphotos; features of both valley and continental glaciers are described and illustrated on accompanying map 1222A. Tintina Trench, locus of a major fault, trends northwesterly across the map-area. Northwest of the Trench, Proterozoic sedimentary rocks are overlain by a Carboniferous sequence which is succeeded by a Permian–Triassic volcanic-sedimentary unit. Southwest of the Trench are Cambrian–Mississippian, and Permian–Triassic sequences. Ages were assigned by correlation with nearby areas. Extensive granitic batholiths are probably late Mesozoic. Modal analyses are tabulated for these and for Paleozoic ultramafic rocks that occur in one place. Folds vary in trend from east to northwest. A lead–zinc–silver deposit east of Little Salmon Lake is the only important deposit.—ESL

00214 **Canada Geological Survey.** Aeromagnetic map, Badger, Newfoundland: Canada Geol. Survey Geophysics Paper 176, scale 1:63,360, revised 1968; originally published 1954.

00215 **Canada Geological Survey.** Aeromagnetic map, Buchans, Newfoundland: Canada Geol. Survey Geophysics Paper 177, scale 1:63,360, revised 1968; originally published 1954.

00216 **Canada Geological Survey.** Aeromagnetic map, Mount Peyton, Newfoundland: Canada Geol. Survey Geophysics Paper 178, scale 1:63,360, revised 1968; originally published 1954.

00217 **Canada Geological Survey.** Aeromagnetic map, Gander, Newfoundland: Canada Geol. Survey Geophysics Paper 179, scale 1:63,360, revised 1968; originally published 1954.

00218 **Canada Geological Survey.** Aeromagnetic map, Grand Falls, Newfoundland: Canada Geol. Survey Geophysics Paper 180, scale 1:63,360, revised 1968; originally published 1954.

00219 **Canada Geological Survey.** Aeromagnetic map, West Gander Rivers, Newfoundland: Canada Geol. Survey Geophysics Paper 184, scale 1:63,360, revised 1968; originally published 1954.

00220 **Canada Geological Survey.** Aeromagnetic map, Dead Wolf Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 185, scale 1:63,360, revised 1968; originally published 1954.

00221 **Canada Geological Survey.** Aeromagnetic map, Miguels Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 186, scale 1:63,360, revised 1968; originally published 1954.

00222 **Canada Geological Survey.** Aeromagnetic map, Lake Ambroise, Newfoundland: Canada Geol. Survey Geophysics Paper 187, scale 1:63,360, revised 1968; originally published 1954.

00223 **Canada Geological Survey.** Aeromagnetic map, Noel Paul's Brook, Newfoundland: Canada Geol. Survey Geophysics Paper 188, scale 1:63,360, revised 1968; originally published 1954.

00224 **Canada Geological Survey.** Aeromagnetic map, Gambo, Newfoundland: Canada Geol. Survey Geophysics Paper 190, scale 1:63,360, revised 1968; originally published 1954.

00225 **Canada Geological Survey.** Aeromagnetic map, Great Gull Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 191, scale 1:63,360, revised 1968; originally published 1954.

00226 **Canada Geological Survey.** Aeromagnetic map, Kepenkeck Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 192, scale 1:63,360, revised 1968; originally published 1953.

00227 **Canada Geological Survey.** Aeromagnetic map, Snowshoe Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 193, scale 1:63,360, revised 1968; originally published 1954.

00228 **Canada Geological Survey.** Aeromagnetic map, Burnt Hill, Newfoundland: Canada Geol. Survey Geophysics Paper 194, scale 1:63,360, revised 1968; originally published 1954.

00229 **Canada Geological Survey.** Aeromagnetic map, Great Burnt Lake, Newfoundland: Canada Geol. Survey Geophys. Paper 195, scale 1:63,360, revised 1968; originally published 1954.

00230 **Canada Geological Survey.** Aeromagnetic map, Glovertown, Newfoundland: Canada Geol. Survey Geophysics Paper 200, scale 1:63,360, revised 1968; originally published 1955.

00231 **Canada Geological Survey.** Aeromagnetic map, Pudops Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 201, scale 1:63,360, revised 1968; originally published 1954.

00232 **Canada Geological Survey.** Aeromagnetic map, Mount Sylvester, Newfoundland: Canada Geol. Survey Geophysics Paper 202, scale 1:63,360, revised 1968; originally published 1954.

00233 **Canada Geological Survey.** Aeromagnetic map, Meta Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 203, scale 1:63,360, revised 1968; originally published 1954.

00234 **Canada Geological Survey.** Aeromagnetic map, Twillick Brook, Newfoundland: Canada Geol. Survey Geophysics Paper 204, scale 1:63,360, revised 1968; originally published 1954.

00235 **Canada Geological Survey.** Aeromagnetic map, Burnt Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 205, scale 1:63,360, revised 1968; originally published 1954.

00236 **Canada Geological Survey.** Aeromagnetic map, Dashwoods Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 206, scale 1:63,360, revised 1968; originally published 1954.

00237 **Canada Geological Survey.** Aeromagnetic map, King George IV Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 207, scale 1:63,360, revised 1968; originally published 1954.

00238 **Canada Geological Survey.** Aeromagnetic map, Cold Spring Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 208, scale 1:63,360, revised 1968; originally published 1954.

00239 **Canada Geological Survey.** Aeromagnetic map, Tug Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 211, scale 1:63,360, revised 1968; originally published 1954.

00240 **Canada Geological Survey.** Aeromagnetic map, Port Blandford, Newfoundland: Canada Geol. Survey Geophysics Paper 229, scale 1:63,360, revised 1968; originally published 1955.

00241 **Canada Geological Survey.** Aeromagnetic map, Howley Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 249, scale 1:63,360, revised 1968; originally published 1956.

00242 **Canada Geological Survey.** Aeromagnetic map, Puddle Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 250, scale 1:63,360, revised 1968; originally published 1956.

00243 **Canada Geological Survey.** Aeromagnetic map, Main Gut, Newfoundland: Canada Geol. Survey Geophysics Paper 251, scale 1:63,360, revised 1968; originally published 1956.

00244 **Canada Geological Survey.** Aeromagnetic map, Stephenville, Newfoundland: Canada Geol. Survey Geophysics Paper 268, scale 1:63,360, revised 1968; originally published 1955.

00245 **Canada Geological Survey.** Aeromagnetic map, Harry's River, Newfoundland: Canada Geol. Survey Geophysics Paper 269, scale 1:63,360, revised 1968; originally published 1956.

00246 **Canada Geological Survey.** Aeromagnetic map, Star Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 270, scale 1:63,360, revised 1968; originally published 1956.

00247 **Canada Geological Survey.** Aeromagnetic map, Little Grand Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 271, scale 1:63,360, revised 1968; originally published 1956.

00248 **Canada Geological Survey.** Aeromagnetic map, Corner Brook, Newfoundland: Canada Geol. Survey Geophysics Paper 272, scale 1:63,360, revised 1968; originally published 1956.

00249 **Canada Geological Survey.** Aeromagnetic map, Rainy Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 273, scale 1:63,360, revised 1968; originally published 1956.

00250 **Canada Geological Survey.** Aeromagnetic map, Mainland, Newfoundland: Canada Geol. Survey Geophysics Paper 274, scale 1:63,360, revised 1968; originally published 1955.

00251 **Canada Geological Survey.** Aeromagnetic map, Serpentine, Newfoundland: Canada Geol. Survey Geophysics Paper 275, scale 1:63,360, revised 1968; originally published 1956.

00252 **Canada Geological Survey.** Aeromagnetic map, Shag Island, Newfoundland: Canada Geol. Survey Geophysics Paper 276, scale 1:63,360, revised 1968; originally published 1955.

00253 **Canada Geological Survey.** Aeromagnetic map, St. Fintans, Newfoundland: Canada Geol. Survey Geophysics Paper 316, scale 1:63,360, revised 1968; originally published 1956.

00254 **Canada Geological Survey.** Aeromagnetic map, Little Friars Cove, Newfoundland: Canada Geol. Survey Geophysics Paper 317, scale 1:63,360, revised 1968; originally published 1956.

00255 **Canada Geological Survey.** Aeromagnetic map, Flat Bay, Newfoundland: Canada Geol. Survey Geophysics Paper 318, scale 1:63,360, revised 1968; originally published 1956.

00256 **Canada Geological Survey.** Aeromagnetic map, Gander Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 7048, scale 1:253,440, 1968.

00257 **Canada Geological Survey.** Aeromagnetic map, Red Indian Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 7049, scale 1:253,440, 1968.

00258 **Canada Geological Survey.** Aeromagnetic map, Stephenville, Newfoundland: Canada Geol. Survey Geophysics Paper 7050, scale 1:253,440, 1968.

00368 **Canada Geological Survey.** Report of activities, Pt. A—May to October, 1967: Canada Geol. Survey Paper 68–1, pt. A, 230 p., illus., table, 1968.

This report presents 145 brief papers on field work [Appalachian and Cordilleran geology, coal, engineering geology, geochronology, geophysics, mineral deposits, Precambrian and Quaternary geology, paleontology, petrology, and stratigraphy and structure] undertaken in 1967 by members of the Geological Survey of Canada and eight additional statements on mineralogical and paleontological collecting projects.—Author's abstract

06328 **Canada Geological Survey.** Aeromagnetic map, Clarke Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4607, scale 1:63,360, 1967.

06329 **Canada Geological Survey.** Aeromagnetic map, Wassegam Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4608, scale 1:63,360, 1967.

06330 **Canada Geological Survey.** Aeromagnetic map, Montreal Lake North, Saskatchewan: Canada Geol. Survey Geophysics Paper 4609, scale 1:63,360, 1967.

06331 **Canada Geological Survey.** Aeromagnetic map, Meeyomoot Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4610, scale 1:63,360, 1967.

06332 **Canada Geological Survey.** Aeromagnetic map, Little Bear Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4611, scale 1:63,360, 1967.

06333 **Canada Geological Survey.** Aeromagnetic map, Big Sandy Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4612, scale 1:63,360, 1967.

06334 **Canada Geological Survey.** Aeromagnetic map, Seager Wheeler Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4613, scale 1:63,360, 1967.

06335 **Canada Geological Survey.** Aeromagnetic map, Saunders Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4614, scale 1:63,360, 1967.

06336 **Canada Geological Survey.** Aeromagnetic map, Suggi Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4615, scale 1:63,360, 1967.

06337 **Canada Geological Survey.** Aeromagnetic map, Leonard Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4616, scale 1:63,360, 1967.

06338 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 99 A/SE and part of 89 B/SW, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4885, scale 1:126,720, 1967.

06339 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheets 89 C/NW and 89 C/NE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4894, scale 1:126,720, 1967.

06340 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 C/NE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4901, scale 1:126,720, 1967.

06341 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 C/NW, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4902, scale 1:126,720, 1967.

06342 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheets 99 E/SE and 89 C/NE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4903, scale 1:126,720, 1967.

06343 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 E/SE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4907, scale 1:126,720, 1967.

06344 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 E/NE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4915, scale 1:126,720, 1967.

06345 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 F/NE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4917, scale 1:126,720, 1967.

06346 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheets 99 G/SE and 99 H/SW, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4919, scale 1:126,720, 1967.

06347 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 H/SE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4921, scale 1:126,720, 1967.

06348 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 G/SE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4923, scale 1:126,720, 1967.

06349 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 G/SW, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4924, scale 1:126,720, 1967.

06350 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheets 99 G/NW and 99 G/NE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4925, scale 1:126,720, 1967.

06351 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 H/NE and part of 1000 B/SE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4926, scale 1:126,720, 1967.

06352 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 H/NW, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4927, scale 1:126,720, 1967.

06353 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 G/NE, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4928, scale 1:126,720, 1967.

06354 **Canada Geological Survey.** Aeromagnetic map, Polar Continental Shelf, Sheet 109 G/NW, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4929, scale 1:126,720, 1967.

06211 **Cannon, Helen L.; Davidson, David F.** (editors). Relation of geology and trace elements to nutrition—A symposium, New York, 1963: Geol. Soc. America Spec. Paper 90, 68 p., illus., tables, 1967.

This symposium contains 12 articles and abstracts dealing with the title subject; each is cited individually by its author. Some of the abstracts are from already-published papers which have been selectively abstracted by the editors for this report.—HRC

00186 **Card, K. D.** (compiler). Sudbury mining area, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 405, scale 1 in. to 1 mi., revised 1968; originally published 1967.

06054 **Card, K. D.** Bay of Islands–McGregor Bay area—Bay of Islands sheets (west half and east half), Districts of Sudbury and Manitoulin: Ontario Dept. Mines Prelim. Geol. Maps P. 440–441, scale 1 in. to 1/4 mi., text, 1967.

The southern half of the map-area is underlain by Paleozoic limestone, dolomite, shale, conglomerate, and sandstone of the Ordovician Trenton–Black River Group; these rocks are shown on Canada Geol. Survey Map 351A (1938). Paleozoic rocks unconformably overlie a sequence of Precambrian metasediments and intrusions. The dominantly clastic Huronian metasediments are divisible into six litho-stratigraphic formations; several bodies of Nipissing-type metagabbro, generally sill-like but transgressive in detail, intrude them. The major structural element is the McGregor Bay anticline whose axis strikes E–W; minor structures indicate three main periods of deformation. Regional metamorphism in greenschist facies has caused widespread development of amphibole, phlogopite, chlorite, and scapolite. Highly-cleaved micaceous quartzites of the Mississagi Formation are reportedly used as tiling material.—MCM

06090 **Card, K. D.** (compiler). Cartier sheet, Districts of Sudbury and Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 287, scale 1 in. to 2 mi., revised 1967; originally published 1965.

06091 **Card, K. D.** (compiler). Westree sheet, Districts of Sudbury and Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 300, scale 1 in. to 2 mi., revised 1967; originally published 1965.

06092 **Card, K. D.** Bay of Islands–McGregor Bay area—McGregor Bay sheets (west half and east half), Districts of Sudbury and Manitoulin: Ontario Dept. Mines Prelim. Geol. Maps P. 442–443, scale 1 in. to 1/4 mi., text, 1967.

The map-area is underlain by Precambrian rocks except in the southwest corner where Ordovician limestone and shale unconformably overlap the older rocks; the latter are shown on Canada Geol. Survey Map 351A (1938). Precambrian rocks

include Huronian metasediments and younger mafic intrusions. Quartzites of the Mississagi are exposed in the McGregor Bay anticline's axial zone. Metasediments, dominantly clastic, are intruded by bodies of Nipissing-type metagabbro. Major structural element is the McGregor Bay anticline whose axis strikes E–W and plunges east at an average angle of 15°. Minor structures indicate three main periods of deformation. Regional metamorphism in upper greenschist facies has caused widespread development of amphibole, phlogopite, scapolite, and chlorite. The first Ontario nickel discovery was at Wallace mine; there are sulfide occurrences in several formations.—MCM

06392 **Cardwell, G. T.; Forbes, M. J., Jr.; Gaydos, M. W.** Water resources of the Lake Pontchartrain area, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 12, 105 p., illus., tables, 1967.

Large quantities of fresh water of excellent quality are available from artesian aquifers in the Lake Pontchartrain area and from streams north of the lake. Shallow aquifers lie beneath the entire lake, but some deep aquifers to the north are 2,000–3,000 feet deep. With threat of salt-water encroachment, withdrawal sites should be as far north of interfaces as is practical. A fault just south of Fort Pike that may form a barrier could influence development. Water levels range from near sea level in shallow aquifers to 120 feet above sea level in the deep ones; hydraulic gradients are very low and slope to the north, except in shallow aquifers affected by pumping in the New Orleans area. Salty water from Lakes Pontchartrain and Borgne intrude stream channels during periods of low flow and storms.—GDC

06270 **Carlson, Ernest H.** The growth of HgS and $Hg_3S_2Cl_2$ single crystals by a vapor phase method: Jour. Crystal Growth, v. 1, no. 5, p. 271–277, illus., tables, 1967.

The solid–vapor system HgS–HCl was investigated by means of the closed tube method, using a gradient furnace. Crystals of the high temperature phase of HgS, metacinnabar, were obtained even below the transition temperature of 344°C; on cooling, however, the structure inverted to that of cinnabar. In the temperature scheme 398–295°C, crystals of $Hg_3S_2Cl_2$ were obtained in the cool zone. A modification of this method of crystal growth may prove useful for growing single crystals of several mercury–halogen–chalcogenides.—*from* Author's abstract

00184 **Carlson, R. C.; Stearns, R. T.; Berens, H. B.; Hearst, J. R.** High-resolution seismic uphole surveys at the Lawrence Radiation Laboratory: Geophysics, v. 33, no. 1, p. 78–87, illus., tables, 1968.

Methods have been developed to measure the source and arrival times of an explosion-induced acoustic wave to within 0.1 ms. These methods have been used to measure acoustic velocity over distances of 10–150 m with high accuracy. The methods are usable in dry holes. They have been used in rhyolite, tuff, dolomite, alluvium, and shale to measure velocities between 700 and 5,000 m per sec. Statistical errors on the order of ±2–5 percent were achieved in most cases. It is concluded that the accuracy of such measurements is limited only by the frequency transmission of the medium, not by the instrumentation.—Authors' abstract

00319 **Carmichael, C. M.** An outline of the intensity of the paleomagnetic field of the earth: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 351–354, illus., 1967 [1968].

An outline of the paleomagnetic field intensity from 2.9×10^9 yr to the present has been obtained from igneous rocks, mainly basaltic lavas, that have been shown to have paleomagnetic stability. The field had an intensity equal to or larger than at present during the Precambrian. Near the end of the Precambrian and the early part of the Paleozoic it was quite weak, then increased during the Mesozoic and Tertiary to present values. The scatter in the values is consistent with a short term variation in intensity of a factor of four being superimposed on the long term trend.—Author's abstract

06255 **Carrigy, M. A.** The physical and chemical nature of a typical tar sand—Bulk properties and behaviour [with French and Spanish abs.], *in* Drilling and

production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 573–581, illus., tables, 1967.

Taking the Athabasca deposit of Alberta, Canada, to be typical, the author discusses the lithology of the host formation, the variability of its important properties, and its post-depositional history. The results of field and/or laboratory tests of important physical properties of the Athabasca tar sand are presented and discussed. Included are measurements of formation temperature, thermal conductivity and specific heat, density, porosity, permeability, and strength. The thermal properties of the tar sand components and some physical properties of the bitumen are similarly treated. Comments are given on the problems encountered and apparatus modification required in tar sands testing.—Author's abstract

Carroll, R. D. *See* Scott, J. H. 00376

Carstea, D. D. *See* Harward, M. E. 06198

Carstens, M. R. *See* Charmonman, Srisakdi. 06135

Carter, Neville L. *See* Heard, Hugh C. 00274

Cashion, W. B. *See* Donnell, John R. 06259

00307 **Cassidy, Martin M.** Excello Shale, northeastern Oklahoma—Clue to locating buried reefs: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 295–312, illus., tables, 1968.

Analytic and petrologic studies of both detrital and chemical components of the Pennsylvanian Excello Shale Member of the Senora Formation in northeastern Oklahoma divide the shale member into a northern carboniferous facies and a southern bituminous facies. The change occurs just south of a limestone reef in the underlying Breezy Hill Limestone Member. Continued study and shale-facies mapping will aid in determining the subsurface position of the reef and the distribution of environments of shale deposition. In shales, clay mineralogy is only a general indicator of environment. Other components such as iron, phosphate, carbonate, organic matter, zeolites, and trace elements are more sensitive to environmental change.—BHK

00266 **Catacosinos, Paul A.** Upper Cretaceous–lower Tertiary relations west of Raven Ridge, Uintah County, Utah: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 343–348, illus., table, 1968.

Field work indicates that the upper Mesaverde, Wasatch, Green River, and Uinta Formations are stratigraphically conformable. The lacustrine Green River sequence is interpreted to intertongue with and grade laterally into nonlacustrine strata of the Wasatch and Uinta Formations.—WCC

00317 **Catanzaro, E. J.** Absolute isotopic abundance ratios of three common lead reference samples: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 343–346, tables, 1967 [1968].

Solid-sample mass spectroscopy was used on three lead reference samples. The resulting absolute values are as follows: GS 4, $Pb^{204}/Pb^{206} = 0.061888 \pm 0.000065$; $Pb^{207}/Pb^{206} = 0.95342 \pm 0.00036$; $Pb^{208}/Pb^{206} = 2.2181 \pm 0.0010$; NBS 200, $Pb^{204}/Pb^{206} = 0.068353 \pm 0.000072$, $Pb^{207}/Pb^{206} = 1.00538 \pm 0.00038$, $Pb^{208}/Pb^{206} = 2.3675 \pm 0.0011$; C.I.T. Pb Std., $Pb^{204}/Pb^{206} = 0.060151 \pm 0.000063$, $Pb^{207}/Pb^{206} = 0.93081 \pm 0.00035$, $Pb^{208}/Pb^{206} = 2.1835 \pm 0.0010$. The indicated uncertainties are overall limits of error based on 95 percent confidence limits for the mean and allowances for effects of known sources of possible systematic error.—*from* Author's abstract

06443 **Cervera, Eduardo.** Exploration and production in Mexico [with French and Spanish abs.], *in* Latest development within the oil industry—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 1B: London, Elsevier Publishing Co., p. 3–23, illus., tables, 1967.

This article is a review of the Mexican oil industry from 1863 to 1966, with emphasis on the accomplishments of 1965. Four of Mexico's principal petroleum provinces are discussed, including a few remarks on the geology of each: northeastern, Tampico–Nautla embayment, Vera Cruz embayment, and the Isthmus and Tabasco region. Results of the intensive exploration program begun in 1965 are summarized for that year. Rather full data is given on Mexico's reserves and production up to the end of 1965, with the figures tabulated by fields. Drilling, well completion, secondary recovery, and other engineering and economic aspects of the industry are treated.—KAR

06144 **Chanda, S. K.** Selective recrystallization in limestones: Sedimentology, v. 8, no. 1, p. 73–76, illus., 1967.

Structurally initiated recrystallization is of two types: in the first type, the common one, the effect is internal and self-destructive, and in the second type the effect is external and leads to the retention of pre-existing structures.—Author's summary

06167 **Chang, Feng-Ming; Simons, Daryl B.; Richardson, Everett V.** Total bed-material discharge in alluvial channels [with French abs.], Paper A17 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 132–140, illus.; discussion and reply, ibid., V. 5, p. 50–51, 60, 1967.

In this study, partially based on existing theories, the bedload discharge was obtained by utilizing the energy-work relation of fluid and bed material. An equation for velocity distribution was obtained by integrating the Reynolds equations, using Prandtl's hypothesis of mixing length. Applying the basic equation for the distribution of suspended load by O'Brien, the suspended bed-material discharge was investigated in terms of bedload discharge. Then, the total bed-material discharge was obtained simply by adding the bedload discharge and the suspended bed-material discharge. The results through checking with available laboratory and field data appeared to be mutually consistent and satisfactory.—*from* Authors' abstract

Chang, Ting P. *See* Toebes, G. H. 06172

06135 **Charmonman, Srisakdi; Carstens, M. R.; May, George D.** A fresh-water canal as a barrier to salt-water intrusion [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 374–382, illus., tables, 1967.

The seepage flow pattern is determined for flow from a fresh-water canal which parallels the sea. Numerical results are presented for cases in which the fresh-water seepage from the land is a small fraction of the fresh-water seepage from the canal. In other words, the fresh-water flow from the canal acts as a dam forcing the interface between the sea water and the fresh water down to a lower elevation. The solution of Laplace's equation is obtained by numerical methods for this flow situation with the boundary conditions involving a water table and a density interface. The possibility of using a fresh-water canal for agricultural reclamation of sea-water intruded deltas and marshes is discussed.—Authors' summary

06250 **Cheatham, J. M., Jr.; Gnirk, P. F.** Review of the fundamental aspects of rock deformation and failure [with French abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 3–26, illus., 1967.

This review considers fundamentals of the mechanical behavior of rock and methods of analysis of problems involving rock deformation and failure as encountered in the petroleum industry. Current knowledge on rock behavior, including brittle fracture, plastic flow, creep, and impact phenomena are discussed, and the scope and limitations of methods of analysis of rock mechanics including theories of elasticity, viscoelasticity, plasticity, and wave propagation are presented. Specific examples of problems encountered such as determination of *in situ* earth stresses, wellbore stability, hydraulic fracturing, drilling, and seismic wave propagation are given along with the current status and reliability of existing solutions.—*from* Authors' abstract

Chesterman, Charles W. *See* Gross, Eugene B. 06388

06106 **Chun, Robert Y. D.; Weber, Ernest M.; Mido, Kiyoshi W.** Planned utilization of ground water basins—Studies conducted in southern California [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 426–434, illus., 1967.

In the coastal plain of Los Angeles County, more than half the water supply comes from ground water basins. Engineering and economic information was developed on a wide range of alternative plans for meeting requirements. One of the new techniques utilized is a nonlinear mathematical model to simulate dynamic behavior. Comprehensive field studies provided the data and a computer was used to develop and test the model. General procedures for setting up the nodal network and model parameters are given, and an on-line digital plot technique is also described. A verified model of the basin makes it possible to achieve reliable results for evaluation of physical feasibility and comparative costs of management plans. Results of the operational-economic analyses of plans for this area have broad application in similar areas.—*from* Authors' abstract

00170 **Church, Clifford C.** Lower Cretaceous Foraminifera of the Orchard Peak–Devil's Den area, California: California Acad. Sci. Proc., 4th ser., v. 32, no. 18, p. 523–580, illus., 1968.

A large fauna from the Hex Formation at Hex Hill and the Devil's Den, in Kern County, is described and illustrated. Of interest is the great preponderance of the Nodosariidae, the small number and size of planktonic species, the presence of genera not found in the Upper Cretaceous of California, the similarity of the fauna with the Lower Cretaceous Valanginian of Germany and Trinidad, and the presence of genera and species previously unknown in California. All in all, 88 species are described, of which 69 are calcareous.—HRC

Clark, Dana K. *See* Graham, Joseph J. 06359

Clark, Joan R. *See* Coleman, R. G. 00276

Clark, Joan R. *See* Burnham, Charles W. 05991

06024 **Clarke, P. J.** Gras Lake–Félix Lake area, Saguenay County [also French edition]: Quebec Dept. Nat. Resources Geol. Rept. 129, 61 p., illus., tables, geol. maps, 1967.

Archean granulites occur at intervals along an E–W band between Hobdad Lake and Moisie River, and are bounded by Proterozoic gneisses and migmatites. Marble, quartzite and iron-formation comprise the Gagnon Group in a southern extension of the Labrador trough, overlain by metasedimentary rocks; igneous intrusives cut the above groups. East of Moisie River gabbro is abundant and Gagnon rocks absent. The petrology is described and mineral composition and chemical analyses given. Geologic maps for the two parts of the area locate assessed mining claims. Main fold axes trend NE and NW and some cross-folding results in a grid pattern and thickening in the iron-formation, which forms hills within synclines. There are some sulfide showings, kyanite in rock blocks, and sand and gravel are available from glacial deposits.—GDC

00167 **Cloud, William K.; Knudson, Charles F.** Preliminary engineering seismological report, *in* The Fairbanks, Alaska, earthquakes of June 21, 1967: Washington, D.C., U.S. Environmental Sci. Services Adm., Coast and Geod. Survey, p. 33–60, illus., tables, 1968.

An accelerograph and ten seismoscopes were installed in the Fairbanks area, as part of a larger program, after the 1964 Prince William Sound earthquake. Records obtained from these during the earthquakes that began on June 21, 1967, are presented in context with effects of the earthquakes. A maximum intensity of VII was assigned to Fairbanks and areas just south and southeast of the city; the engineering and geologic effects at this intensity and for the Intensity V and VI zones are described. A photocopy of the accelerogram and velocity and displacement

response spectra are included. The anomalous response of one seismograph was due to its location on a sequence of thawed silt above 52 feet of permafrost and 155 feet of unfrozen silt. The records suggest a fault strike of N. 60° W. and an epicenter just east of Fairbanks.—ESL

06418 **Cloud, William K.** Seismoscope results from three earthquakes in the Hollister, California, area: Seismol. Soc. America Bull., v. 57, no. 6, p. 1445–1448, illus., 1967.

Seismoscope records from a magnitude 5.0 earthquake on January 19, 1960, and from magnitude 5.6 and 5.5 earthquakes on April 8, 1961, in the Hollister, California, area, like those from the Parkfield, California, main shock of June 27, 1966, indicate that the maximum amplitude of transient motion in close proximity to the San Andreas Fault was oriented at a large angle to the strike of the fault.—Author's abstract

Coffin J. *See* Figueroa, S. 06450

06129 **Cohen, Philip; Durfor, C. N.** Artificial recharge experiments utilizing renovated sewage plant effluent—A feasibility study at Bay Park, U.S.A. [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 193–199, illus., 1967.

A series of experiments is being conducted on Long Island designed to obtain data needed to evaluate the feasibility of injecting highly treated effluent into a network of barrier wells to prevent landward movement of salt water in major aquifers. A sewage treatment process has been developed to meet the requirements, and an experimental injection well and plant have been completed. The well complex is about 500 feet deep; casings and pipes are equipped with remote sensing downhole geochemical probes to report changes. The experimental injection well and 13 nearby observation wells are providing information regarding the design and hydraulic characteristics of injection wells, hydraulics of the leaky artesian aquifers, and geochemical controls on artificial ground water recharge through wells.—*from* Authors' abstract

00371 **Cohenour, Robert E.; Sharp, Byron J.** The impact theory—Asteroids and the Earth Moon system: GeoScience News, v. 1, no. 3, p. 8–11, 32–34, illus., 1968.

Circular scars on both Mars and the Moon are recognized as being impact craters. The fact that few scars are recognized on the Earth is due to erosion and covering with sediments by invading seas. Collision with asteroids occurred in flurries and could have ended geologic periods. An asteroid could have a velocity of 72.5 kmps in a head on collision; the energy is explosive and crustal layers would be crushed, folded, and faulted, and rocks fused and melted. Phenomena which develop in such impacts are reconstructed. It is believed that asteroidal impacts are the most probable cause of large circular depressions on the ocean bottom, but not of the entire basin. The Gulf of Mexico and two large areas in Siberia are probably impact craters. If these impacts prove to be a factor in distribution and structure of the crust, many current concepts will be subject to revision.—ESL

06152 **Coleman, Neil L.** A theoretical and experimental study of drag and lift forces acting on a sphere resting on a hypothetical streambed [with French abs.],Paper C22 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 3: Fort Collins, Colo., Colorado State Univ., p. 185–192, illus.; discussion, ibid., V. 5, p. 456, 1967.

A critical force equation is derived for the case of a sphere resting on a bed of similar spheres, considering effects of both interparticle geometry and action of a supposed lift force; experiments based on the analysis are described. The drag coefficient–Reynolds number function for the sphere at rest on a bed is shown to be essentially the same as for a sphere in free fall over a range of Reynolds numbers from about 50 to 9400. A lift factor in the critical force equation is shown to be dependent on the particle Reynolds number; evidence presented indicates that the algebraic sign of this lift number may depend on the presence or absence of a laminar sublayer in the flow in the vicinity of the sphere. Extension of these

analytic and experimental results to the case of incipient motion of real sediment particles is briefly discussed.—*from* Author's summary

00276 **Coleman, R. G.; Clark, Joan R.** Pyroxenes in the blueschist facies of California: Am. Jour. Sci., v. 266, no. 1, p. 43–59, illus., tables, 1968.

In the Franciscan Formation pure end-member jadeite is restricted to metasomatized leucocratic masses within serpentinite. Jadeitic pyroxene coexists with quartz in metagraywackes, and omphacite or acmitic pyroxene are present in metabasalts; metacherts contain acmitic pyroxene. Chemical, optical, and X-ray parameters of pyroxenes from representative rocks show strong variations related to rock composition. Experimentally, jadeite and related pyroxenes are favored by high pressures. In silica-deficient serpentinites, pure jadeite forms, whereas in other rock types, under the same metamorphism, where excess silica is present, only jadeite pyroxene and omphacite are stable.—*from* Authors' abstract

06308 **Colton, Harold S.** The basaltic cinder cones and lava flows of the San Francisco Mountain Volcanic Field: Flagstaff, Ariz., Museum of Northern Arizona, 58 p., illus., revised 1967; originally published 1936.

In central Arizona an erosion surface was formed by the end of the Pliocene with the land standing near sea level; basaltic lava flows occurred toward the end of the period, then were covered by layers of acid or intermediate lavas. During the Pleistocene, basaltic activity occurred again, and hundreds of cinder cones developed. In the survey, 422 vents have been listed and the flows outlined to determine the history. To classify the basaltic flows, five groups based on stage of erosion are used, and examples of each are described. Accessory phenomena include classification by viscosity, intercone basins, collapsed cinder cones, ash beds, lava tunnels and lakes, squeeze-ups, gas bubbles, splashes, and consequent drainages. A map of cones and flows accompanies the report.—ESL

05982 **Condie, Kent C.** Petrology of the late Precambrian tillite(?) association in northern Utah: Geol. Soc. America Bull., v. 78, no. 11, p. 1317–1343, illus., tables, 1967.

The late Precambrian subgraywackes of northern Utah and adjacent areas are poorly sorted, commonly graded, and contain bent reworked subgraywacke fragments. Such features suggest an origin by turbidity currents or subaqueous mudflows, although a contemporary glaciation cannot be eliminated because glacial sediments may be redeposited by these agents. The subgraywackes and conglomeratic subgraywackes consist chiefly of rounded quartz and minor feldspar grains and rock fragments in a secondary matrix of mica, chlorite, and quartz. The clastic components suggest a plutonic- and quartzite-rich source area. Differences in mineralogy and chemical composition between metamorphosed and unmetamorphosed rocks are attributed to variations in the original sediment in combination with changes accompanying progressive metamorphism.—ATO

06355 **Condie, Kent C.** Late Precambrian rocks of the northeastern Great Basin and vicinity—A reply [to L. A. Woodward's discussion of 1966 paper]: Jour. Geology, v. 75, no. 5, p. 638–639, 1967.

In reply to Woodward (ibid., p. 635–637), Condie corrects the several "minor editorial or quotational errors" (ibid., v. 74, no. 5, pt. 1, p. 631–636, 1966). He points out that of published papers available at the time the article was submitted, only the paper by Woodward, 1963, was overlooked. Some questions of interpretation are examined further.—VSN

Condon, W. H. *See* Hoare, J. M. 00332

Connor, J. J. *See* Hinrichs, E. N. 00333

Conover, W. Jay. *See* Sayre, William W. 06165

05999 **Conrey, Bert L.** Early Pliocene sedimentary history of the Los Angeles Basin, California: California Div. Mines and Geology Spec. Rept. 93, 63 p., illus., tables, 1967.

Lower Pliocene strata in the basin are from 0–5,000 feet thick and consist principally of clastic rocks. Thickness, texture, composition, and fauna show depositional environments, source areas, and transportation. It was a deep marine basin in early Pliocene; margins are identified by submarine fans and slump aprons, sedimentary pinch-outs, and angular unconformities. The basin was separated from the sea by a sill, several thousand feet below sea level. Bottom waters were cold, deficient in oxygen, and moved west and south; surface waters had low salinity. An average yearly depositional rate of 0.07 cm is estimated. Tectonic instability of the floor contributed to variations in thickness. Sediments were brought in by turbidity currents, submarine slumps, and surface currents. Principal source areas of the 7 identified were the San Gabriel Mts. and Puente Hills. Three cross sections accompany the report.—ESL

Cook, Frank A. *See* Hamelin, Louis-Edmond. 06309

06289 **Cook, Kenneth L.; Berg, Joseph W., Jr.; Lum, Daniel.** Seismic and gravity profile across the northern Wasatch trench, Utah, *in* Seismic refraction prospecting (A. W. Musgrave, editor): Tulsa, Okla., Soc. Explor. Geophysicists, p. 539–549, illus., 1967.

The instrumentation, procedures, and interpretation of seismic and gravity surveys (1956–1958) which led to the discovery of the Wasatch trench, Utah, are summarized. Data indicate a great graben, 13 miles in width, in the valley between Little Mountain South and the Wasatch Range. Depth of valley fill is at least 6,200 feet by reflection and 7,600 feet by gravity data. Seismic results indicate that the graben is bounded on the west by two faults east of Little Mountain South and on the east by probably three parallel or sub-parallel faults, the most easterly of which lies along the Wasatch front.—VSN

Cook, Ray L. *See* Bouyoucos, George J. 06179

06432 **Cooper, James B.; Trauger, Frederick D.** San Juan River basin—Geography, geology, and hydrology, *in* Water resources of New Mexico (New Mexico State Engineer Office, compiler): Santa Fe, N. Mex., State Plan. Office, p. 183–197, illus., tables, 1967.

The San Juan River drops 2,000 feet in its bend through northwestern New Mexico, to join the Colorado River in Utah; major tributaries arising in New Mexico are ephemeral. Paleozoic sedimentary rocks underlie most of the basin at depths to 9,000 feet; Precambrian basement has been reached in 2,500- and 5,000-ft wells on the margins; exposed rocks are Triassic to Recent; small Tertiary basalt flows crest the Chuska Mts., and plugs and dike swarms are in northern parts of the basin; structurally asymmetric, the total center thickness is near 15,000 feet. Brief descriptions are summarized in a generalized stratigraphic section, indicating aquifers. Excepting the San Jose and Nacimiento Formations (Tertiary), few units yield much water, and that poor in quality; alluvium is thick enough only in the main valley.—GDC

Cooper, Joseph F. *See* Gross, Eugene B. 06388

06029 **Corlett, M.; Ribbe, P. H.** Electron probe microanalysis of minor elements in plagioclase feldspars: Schweizer. Mineralog. u. Petrog. Mitt., v. 47, no. 1, p. 317–322, illus., table, 1967.

One hundred and fifty seven plagioclase feldspars have been analyzed for K, Sr, Ba, Fe, Ti, and P using microprobe X-ray emission methods. Average concentrations are plotted as a function of anorthite content, showing that K, Ba, and Sr are highest in the andesine composition range, Fe and Ti in the labradorite, and P in the albite, the last correlating directly with Si/Al ratio. Antiperthitic potassium feldspar is found to contain ca. 35 percent more Sr and orders of magnitude more Ba than the plagioclase host from which it is exsolved. Antiperthite

occurs in more than two thirds of the plagioclases examined and accounts for much of the discrepancy between previous analyses of K and Ba and the microprobe analyses. Inclusions account for discrepancies between those of Fe and Ti. Phosphorus was detected in 62 specimens; all but a few with P>0.01 percent are from pegmatites.—*from* Authors' abstract

Craig, R. W. *See* Osment, F. C. 06404

06059 **Crawford, C. B.; Jarrett, P. M.** Discussion—"Landslide on the Toulnustouc River, Quebec," by R. J. Conlon (1966): Canadian Geotech. Jour., v. 4, no. 4, p. 409–410, illus., 1967.

Conlon (ibid., v. 3, no. 3, p. 113–144, 1966) demonstrates conclusively that the ordinary methods of testing and analysis are completely inadequate for assessing stability of heavily overconsolidated, extra-sensitive clay, and develops a concept of behaviour applicable to all such marine and estuarine soils. The writers disagree with his concept of friction mobilization and with one figured, according to which there is no cohesion component except that due to cementation. Results of an experiment on Leda Clay are reported and found to be incompatible with the simple concept of friction as a reaction equal and opposite to the applied shearing stress until movement occurs.—ESL

06147 **Crickmore, M. J.** Measurement of sand transport in rivers with special reference to tracer methods: Sedimentology, v. 8, no. 3, p. 175–228, illus., tables, 1967.

Sand transport occurring over rippled bed in a natural channel is measured quantitatively by tracers. Special fluorescent dyes and radioactive isotopes were used to represent a narrow size fraction of the bed sand. The spatial integration method offers the most workable and informative tracer method for use in natural rivers. Floods, etc. can influence time integration and steady dilution methods. The results agreed with the summation of the measured suspended solids flux and the transport occurring by surface creep or in close vicinity to the bed profile. Various formulas are compared.—*from* Author's summary

Cromwell, John. *See* Broecker, Wallace S. 06232

Culbertson, William C. *See* Donnell, John R. 06259

Cumming, G. L. *See* Folinsbee, R. E. 06286

Cuppels, Norman P. *See* Overstreet, William C. 00323

06251 **Currie, J. B.** Evolution of stress in rocks of a sedimentary basin [with French abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., v. 3: London, Elsevier Publishing Co., p. 41–51, illus., tables, 1967.

Methods of measuring the distribution of stress in rocks of a basin can be grouped in three categories. One category includes methods of direct measurement. The other two comprise methods in which inferences regarding stress are drawn from the geometry of basin structures. In each method deduction of the state of stress and its pattern is based on principles of rock mechanics. These principles find application too in tracing possible changes of stress distribution within a basin from one period of its geological history to another.—Author's abstract

Currie, Robert G. *See* Hirshberg, Joan. 00203

06189 **Curry, R. Bruce.** Deposition of montmorillonite from suspension during flow through porous media, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., v. 27), p. 331–343, illus., table, 1967.

Important factors affecting flow of colloidal suspensions through porous media are particle size and shape, and suspension concentration; hydraulic gradient appears to be relatively less important. Relation of the zeta potential of the porous media and suspended particles is also an important factor. Difficulty in measuring zeta

potential and of producing material with a desired zeta potential make verification of this factor difficult. The mechanism of removal at the surface was mechanical sieving, while that below the surface was a combination of diffusion and gravitational settling. If these mechanisms truly control, then existing theory does not hold for this case. The major deviation is the nonlogarithmic distribution of accumulated material throughout the porous media; this also applies to other theories which appear to be valid for large particle size media and suspensions, but not for relatively fine particle size suspensions.—*from* Author's summary

Curtis, M. R. *See* Tixier, M. P. 06262

Dachille, Frank. *See* White, William B. 06010

06374 **Dahlberg, E. C.; Griffiths, J. C.** Defining gradients in a sample of sedimentary rock: Sedimentology, v. 8, no. 4, p. 291–309, illus., tables, 1967.

Three orthogonal planes (two vertical and one horizontal with respect to the apparent bedding structure) of a core sample of seemingly graded graywacke sandstone have been petrographically analyzed in order to determine the form and characteristics of the lithologic gradients in the specimen. Compositional and textural properties were sampled in thin section. Variability among rows and columns (plus interaction) with respect to each petrographic variable was tested by analysis of variance using a two-way classification. A larger number of properties show significant variation among the rows of the grid (thus in a vertical section) than in the plane of the apparent bedding. Interpretation of sedimentation is very difficult because of the interdependencies.—*from* Authors' summary

00290 **Dalrymple, G. Brent; Doell, Richard R.** Comments on paper by M. Ozima, M. Kono, I. Kaneoka, H. Kinoshita, Kazuo Kobayashi, T. Nagata, E. E. Larson, and D. Strangway, "Paleomagnetism and potassium-argon ages of some volcanic rocks from the Rio Grande gorge, New Mexico" [1967]: Jour. Geophys. Research, v. 73, no. 4, p. 1502–1503, illus., 1968.

The reverse-to-normal transition found by Ozima and his coworkers (ibid., v. 72, p. 2615–2621, 1967) in basalts of the Rio Grande gorge is not the Gauss-Gilbert geomagnetic boundary, but the earlier boundary of a normal event at about 3.7 m.y. Definition of the Gauss-Gilbert polarity transition at 3.35 m.y., as proposed by Doell and others (1966), seems best to fit the fairly numerous data that cluster close to the boundary. Dalrymple and others (1967) have proposed the existence of a normal-to-reversed polarity transition at 3.7±0.1 m.y.; in the light of this, the data of Ozima and others are better interpreted as due to a normal event at 3.6 to 3.7 m.y., within the Gilbert reversed epoch. It is also pointed out that 0.05 m.y. for the time of transition between normal and reversed flow can be claimed only at low confidence level.—DBV

00326 **Dalrymple, G. Brent.** Potassium-argon ages of Recent rhyolites of the Mono and Inyo Craters, California: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 289–298, illus., tables, 1967 [1968].

Twenty-two K-Ar ages were determined for sanidine samples from 10 rhyolite domes of the Mono and Inyo Craters to test the applicability of K-Ar dating to volcanic rocks of Recent age. A statistical analysis suggests that real differences in apparent age were detected between three of the analyzed domes. The ages, which range from 6,400 to 10,200 years for experiments with 5 percent or more radiogenic Ar-40 are, in general, consistent with ionium ages on five of the same samples and with glacial and C-14 evidence of age. They suggest that most of the Mono Craters volcanos are on the order of 10,000 years old or less. The results also suggest that the problem of excess Ar-40 may not be severe for K-Ar dating of volcanic rocks.—*from* Author's abstract

06035 **Dance, S. Peter; Emerson, William K.** Notes on *Morum dennisoni* (Reeve) and related species (Gastropoda, Tonnacea): Veliger, v. 10, no. 2, p. 91–98, illus., 1967.

The holotype of *Morum* (*Cancellomorum*) *dennisoni* (Reeve, 1842), originally *Oniscia dennisoni*, a rare Recent species from Guadeloupe, West Indies, is identified and

redescribed, and new records are listed. An annotated list of names applied to all known living representatives of *Morum* Röding, 1798, under four subgenera, is provided, and a new name, *M. (Cancellomorum) watsoni*, is proposed to replace *M. cithara*, a secondary homonym. An annotated list of fossil representatives of *Morum* reported from the New World contains three species of *Morum* s.s. and 11 species of *Cancellomorum*, ranging from Eocene through Pleistocene and occurring mainly in Florida, Panama, and the West Indies; Tertiary representatives of *Morum* are also known from the Old World.—VMJ

Davidson, David F. *See* Cannon, Helen L. 06211

06410 **Davies, David K.; Bevan, Jacqueline M.** Fortran programme for the analysis and graphical presentation of geological data: Sedimentology, v. 8, no. 2, p. 159–162, illus., 1967.

Computers are being used increasingly for the analysis of quantitative geological data. An outline is given of the advantages of contemporaneously using both computers and connected automatic plotters. It is suggested that the quality of the automatic plotter output is such as to preclude the services of a draftsman in the preparation of many graphics for publication.—Authors' summary

Davies, J. C. *See* Riley, R. A. 06082

06304 **Davis, B. W.** Automatic depth control of seismic streamers, *in* The new thrust seaward—MTS Conf. and Exhibit, 3d Ann., San Diego, Calif., 1967, Trans.: Washington, D. C., Marine Technology Soc., p. 167–184, illus., 1967.

A towing device and the ocean act as independent forcing functions; the former producing an unbalanced vertical force as a result of changes in tow velocity, the ocean contributing an unbalancing vertical force as a result of changes in temperature and salinity. Up welling and down welling ocean currents produce a similar instability effect. As a result, a subsurface towed body in the ocean continually seeks a new depth equilibrium position. In marine exploration for petroleum, long "neutrally buoyant" streamers are employed as seismic receiver arrays; their length will often be greater than one and one-half miles, and their mass greater than seven tons; most desirable towing depth is forty feet. A great deal can be done to minimize effects of unbalancing forces through careful streamer design.—*from* Author's abstract

06097 **Deane, R. E.** The surficial geology of the Hartford South quadrangle (with map): Connecticut Geol. and Nat. History Survey Quad. Rept. 20, 43 p., illus., tables, geol. map, 1967.

Here in the Triassic valley of the Connecticut River, basalt ridges confined Wisconsin glacier flow to S. 12° W. Two tills mantle bedrock to a depth of over 250 feet: a basal that is sandy to stony; and an upper, richer in silt and clay and evidence of Middletown readvance. Glaciofluvial sand and gravel deposits are widespread, ice-contact stratified drift forming the bulk. Varved clays, up to 165 feet thick beneath the river floodplain, were deposited in a series of temporary glacial lakes climaxed by Lake Hitchcock. Beach deposits at 150-ft elevations mark the lake's shoreline; bottom deposits lie below this level and the 45-ft altitude at which Lake Hitchcock became the Connecticut River. Terrace alluvium is limited to the Connecticut and Mattabesset Valleys. Gravel resources are unavailable due to community development.—GDC

06223 **Deeds, C. T.; vanOlphen, H.; Bradley, W. F.** Intersalation and interlayer hydration of minerals of the kaolinite group, *in* Internat. Clay Conf., Jerusalem, Israel, June 1966, Proc., V. 2: Jerusalem, Israel Program Sci. Translations, p. 183–199, illus., tables, 1967.

An extended abstract appeared in V. 1 of the Proceedings, and the full paper and discussions are given here. The paper is divided into three sections: intersalation complexes; interlayer hydrates; and structure interpretation, which includes tables of powder patterns. The complexes are divided into: the 14A potassium acetate complex, its preparation, intersalation reaction, temperature effects, and

composition; formation of other intersalation products by salt exchange; a second intersalation product with potassium acetate, conditions of preparation and composition; and other intersalation complexes prepared from the 21A complex by salt exchange. Discussion of the hydrates is divided into: formation by washing of the 14A intersalation products with water; formation of a mixed layer hydrate from the 21A and 14A intersalation products; and formation of intersalation products from hydrates.—ESL

Delavault, Robert E. *See* Warren, Harry V. 06212

Delevoryas, Theodore. *See* Eggert, Donald A. 06101

della Faille, M. *See* Fripiat, J. J. 06185

06356 **Denison, Robert H.** A new Protaspis from the Devonian of Utah, with notes on the classification of Pteraspididae: Linnean Soc. London Jour.,Zoology, v. 47, no. 311, p. 31–37, illus., 1967.

Recent classifications of Pteraspididae are considered, and it is concluded that because of rapid and sometimes parallel evolution, the ventral face of the rostrum cannot be relied upon as the sole or most important diagnostic feature of a genus. A revised classification, based on several characters, is proposed, as follows: genus *Pteraspis*, including subgenera *Protopteraspis, Althaspis, and Pteraspis*; genus *Rhinopteraspis*; genus *Protaspis*, including subgenera *Protaspis and Cyrtaspidichthys*; genus *Doryaspis* (name preoccupied). A new species from the Early Devonian Water Canyon Formation of northeastern Utah is described as *Protaspis (Protaspis) erroli*.—Author's abstract

00284 **Dennis, John G.; Walker, C. Trevor.** Hypocentral patterns near island arcs [discussion of paper by L. R. Sykes, 1966]: Jour. Geophys. Research, v. 73, no. 4, p. 1506–1507, illus., 1968.

Sykes' (ibid., v. 71, no. 12, p. 2981–3006, 1966) statement that the pronounced change in depth of the zone of deep earthquake activity in the South Pacific indicates that this zone does not seem to be associated with a phase change in the mantle, unless the properties in the upper mantle exhibit large lateral variations along the island arc, is taken to imply that phase changes would be confined to zones narrowly prescribed by upper mantle structure. It is emphasized here that hypocenters of earthquakes resulting from phase transitions cannot normally be expected at or near stability boundaries of mantle phases. Their location depends on the factors that determine the place and rate of migration of mantle currents, on factors controlling kinetics of the transition, and on whether adiabatic transfer is achieved.—DBV

06124 **Deutsch, Morris.** Artificial recharge by induced interaquifer leakage [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 159–172, illus., tables, 1967.

In the Kalamazoo, Mich., area, tests demonstrated the feasibility of recharging an artesian drift aquifer by leakage to it from a surficial sand aquifer. The artesian aquifer consists of sand and gravel in a pro glacial valley, covered by an aquiclude of fine grained sediments; the surficial sand is connected with a creek draining it. The piezometric surface was higher in the lower aquifer, and leakage was upward. Three tests were run by pumping from the lower aquifer with: (1) the head in a small recharge channel to the upper aquifer allowed to decline, (2) the head in the channel maintained by stream diversion; and (3) the channel greatly enlarged, and the head maintained at a constant stage. Rates of leakage from upper to lower aquifer at the end of each test were 1,600–1,900 gpm. After six years of pumping under recharge conditions, water levels remain the same.—*from* Author's abstract

00303 **deVries, M.** River bed degradation below dams—Discussion [of paper 5335 by S. Komura and D. B. Simons, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 5825, Jour. Hydraulics Div., no. HY2, p. 595–597, 1968.

The writer believes that the authors of paper 5335 [ibid., v. 93, no. HY4, p. 1–14, 1967] pay too much attention to the final equilibrium profile of the river bed, and too little to the transient phases.—ESL

deVries, Mattheus. *See* Vreugdenhil, C. B. 06153

06137 **DeWiest, Roger J. M.** Artificial recharge through augmented bank storage [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 53–68, illus., 1967.

A recharge project is being considered in the Princeton area, N.J., in which runoff is returned to a water-table aquifer [Pennsauken] by damming the [Millstone] river and its tributary. Greatest buildup of ground-water level, and discharge to rivers, comes between November and late May. The increased water level in the rivers due to the dams would decrease the hydraulic gradient from the ground-water basin and limit the discharge. As pumping made more storage space available, this fresh water would move into the aquifer. A geohydrologic description of the watershed is given and various physical parameters entering the study are discussed. Green's functions are used to arrive at the solutions.—*from* Author's abstract

06214 **Diem, Kenneth L.** Some aspects of substrate influence on the physioecology of dependent plant and animal populations [abs.], *in* Relation of geology and trace elements to nutrition—A symposium, New York, 1963: Geol. Soc. America Spec. Paper 90, p. 9, 1967.

00330 **Dietrich, R. V.** Behavior of zirconium in certain artificial magmas under diverse P-T conditions: Lithos, v. 1, no. 1, p. 20–29, 1968.

Gels with the compositions $Q_{32}Ab_{38}Ab_{38}Or_{30}$ and $Q_{64}Ab_{33}Or_{27}$—each with 100, 250, 500, or 2000 ppm, 1.0 or 10.0 percent (by weight) Zro_2—have been studied under a range of P-T conditions. Zircon crystallized metastably from each mixture, under most P-T conditions, as well-formed bipyramids (a few with short prism faces) and(or) as skeletal crystals. The metastable nature is indicated by the fact that zircon was not a product of runs at 800°C and 1 kb, of more than 720 hours duration. Addition of small amounts of $Na_2Si_2O_5$ or NaF to the mixtures suppressed crystallization of zircon in short-term runs; this explains the relatively common occurrences where zirconium of sodium-rich igneous rocks is in apparently late-formed minerals other than zircon and(or) in late-formed zircon.—*from* Author's abstract

06452 **Dillon, E. L.** Information storage and retrieval systems [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 555–560, illus., 1967.

Information handling by electronic computer is reviewed. The advantages and inconveniences of encoding at the time of observation, or later from conventional records, are discussed. Logical or open-ended codes are gaining in popularity with geologists because of their flexibility for projects requiring different degrees of detail. Files of such material as well data can become too large for efficient processing by present-day computers. The solution to the problem seems to be utilization of the basic file-peripheral file concept. The problem of data retrieval in geology is illustrated by a FORTRAN program for compiling an isopach map. Systems under development using words or abbreviations having a unique meaning will prove more suitable for the average geologist.—KAR

06386 **Dineley, D. L.** The Lower Devonian Knoydart faunas: Linnean Soc. London Jour.,Zoology, v. 47, no. 311, p. 15–29, illus., 1967.

The presence of *Traquairaspis symondsi and Pteraspis (Simopteraspis) whitei* in the Knoydart Formation of Arisaig and Pictou Counties, Nova Scotia, has been taken as good evidence of the upper part of the Downtonian and the lower part of the Dittonian stages, respectively. Further discoveries of *P. (S.) whitei and Cephalaspis novaescotiae* allow some estimate of the thickness of the lower part of the Dittonian stage (more than 60 feet). Near Ardness a fauna occurring near the top of the

Knoydart Formation includes *Pteraspis (Belgicaspis) crouchi* which confirms a lower Dittonian age for the greater part of the formation.—Author's abstract

Dinneen, G. U. *See* Robinson, W. E. 06257

06406 **Dinwiddie, George A.** Rio Grande basin—Geography, geology, and hydrology, *in* Water resources of New Mexico (New Mexico State Engineer Office, compiler): Santa Fe, N. Mex., State Plan. Office, p. 127–142, illus., tables, 1967.

Precambrian igneous and metamorphic rocks underlie the entire basin; in Sunshine Valley the Sangre de Cristo is the only known Paleozoic formation, but older units occur in southern mountains; the largest Mesozoic exposure is in the San Juan basin. Cenozoic lava flows cap mesas, sills are interbedded with sedimentary rocks, and volcanics are found in the Jemez Mts. A generalized stratigraphic section summarizes the units, their distribution, and properties, and indicates aquifers; reports on their compositions and water yields are reviewed briefly. The very thick Rio Grande trough fill is the most reliable aquifer; the extensive San Andres Limestone is locally prolific.—GDC

Doberenz, Alexander R. *See* Wyckoff, Ralph W. G. 00292

Doell, Richard R. *See* Dalrymple, G. Brent. 00290

06408 **Dolan, Robert.** Photographic beach measurements: Sedimentology, v. 8, no. 1, p. 77–80, illus., 1967.

An automated photographic method is described for recording short-interval changes in sand levels on a natural beach. Results of the photographic technique are compared with profiles obtained by conventional surveying methods. Lapse-time photography offers a wide range of possibilities for accurate and efficient beach measurement when information in large amounts is required.—Author's summary

Dolidze, I. V. *See* Mirtskhulava, Ts. E. 06157

Dollase, W. A. *See* Buerger, M. J. 05984

06017 **Donaldson, Alan C.** Deltaic sands and sandstones, *in* Symposium on recently developed geologic principles and sedimentation of the Permo-Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf., Casper, 1966: Casper, Wyo., Petroleum Inf., p. 31–62h, illus. [1967?].

Deltaic sands accumulate in fluvial and tidal channels, distributary-mouth bars, beach ridges, barrier islands, and on delta-front platforms. Recent Mississippi, Niger, Guadalupe (Texas) and Colorado (Texas) deltas are described to indicate the criteria used in recognizing facies and also for an understanding of the cyclic nature of delta growth. Similar facies are reviewed for comparison from Paleozoic deltas in the central Appalachians and upper Mississippi Valley. Vertical cores of prograding deltas show silts and sands coarsening upward over a gradational contact with underlying prodelta silty clays, while transgressive sediments grade finer upwards with sands resting on erosional surfaces.—*from* Author's abstract

Donnay, J. D. H. *See* Takeda, Hiroshi. 05985

Donnay, J. D. H. *See* Takeda, Hiroshi. 06008

06259 **Donnell, John R.; Culbertson, William C.; Cashion, W. B.** Oil shale in the Green River Formation [with French and Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 699–702, illus., 1967.

Oil shales of the Green River Formation were deposited principally in two great Eocene lakes—Lake Uinta in Colorado and Utah, and Lake Gosiute in Wyoming. During the first depositional phase, the basins were restricted and of saline composition; trona and shortite were deposited with the shales in the Wyoming basin and nahcolite and dawsonite in Colorado. When the basins in Colorado and

Utah united to form the maximum extent of Lake Uinta, the great sequence of rich, thick, and persistent oil shale, the Mahogany ledge or zone, was deposited; thin beds yield up to 90 gal oil per ton and sequences more than 100 feet thick yield 30 gal per ton. Yields in the Wyoming area vary from 10 to 60 gal per ton. About two trillion bbl of oil are contained in the three-State area in shale as thick as 2,000 feet yielding more than 10 gal and averaging more than 15 gal per ton.—VSN

Donnell, John R. *See* Tourtelot, Harry A. 06261

06428 **Doty, Gene C.** Southwestern closed basins—Geography, geology, and hydrology, *in* Water resources of New Mexico (New Mexico State Engineer Office, compiler): Santa Fe, N. Mex., State Plan. Office, p. 250–264, illus., tables, 1967.

Six sub-basins are within this corner of New Mexico, in the Mexican Highland section of the Basin and Range province. Mountain ranges up to 9,000 feet high parallel valleys or bolsons at 4,000 feet. Outcropping rocks are of Precambrian to Recent age, but no Triassic or Jurassic; thick Tertiary volcanic flows cover most of the area; mountain masses are uplifted by block-faulting. A generalized stratigraphic section summarizing unit properties designates the aquifers; a sketch map shows distribution of consolidated rocks. Most of the usable ground water is in heterogeneous Cenozoic bolson deposits, 1,000 feet thick in places, which locally include interbedded volcanics. Paleozoic limestones near Silver City yield some water; mountain area wells and springs derive water from Tertiary and older rocks, but of poor quality near mines.—GDC

Doty, L. F. *See* Warner, D. L. 06132

00344 **Dowdy, R. H.; Mortland, M. M.** Alcohol-water interactions on montmorillonite surfaces—[Pt.] 2, Ethylene glycol: Soil Sci., v. 105, no. 1, p. 36–43, illus., table, 1968.

The infrared data show that Cu, Al, and Ca montmorillonites are completely dehydrated when equilibrated with glycol at a vapor pressure of 35 torr. When the glycol content is greater than 25g/100g clay, rational X-ray diffraction peaks are observed, which range from 16.6A of Ca montmorillonite to 17.1A for Al montmorillonite.—JWH

06196 **Dowdy, R. H.; Mortland, M. M.** Alcohol-water interactions on montmorillonite surfaces—[Pt.] 1, Ethanol, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 259–271, illus., table, 1967.

Equilibration of homoionic montmorillonite films with ethanol vapor at a relative pressure of unity, reduced water content to less than 0.7 percent (300°C). Apparent differences between cation saturations are reconciled by the different types of ion-dipole interactions involved. Adsorption isotherms and X-ray diffraction results substantiated interpretations of infrared data. Spectroscopic and gravimetric studies showed that prolonged evacuation did not remove all adsorbed ethanol. Cu-, Al-, and Ca-montmorillonite retained 4.5, 7.9, and 4.5 molecules per ion, while Na- and NH_4-clays retained less than one molecule per cation. These differences indicate that adsorption and retention of alcohol is affected by the saturating cation and that alcohol and water compete for the same adsorption sites, so ion-dipole type interactions should be considered in adsorption mechanisms.—*from* Authors' abstract

06382 **Drew, J. V.** (and others, editors). Selected papers in soil formation and classification: SSSA Spec. Pub. 1, 428 p., illus., tables, 1967.

The purpose of this volume is to bring together source material dealing with modern concepts in soil formation and classification; it is designed to provide text material and supplemental reading for such a course. The original source of each paper is given in footnotes; dates of publication vary from 1949–1964. Papers are grouped into: characteristics of some genetic soil groups; soil forming factors—concepts and

interpretations; soil genesis—mechanisms and changes; and some concepts in soil classification.—MCM

06271 **Droste, John B.** Clay mineral formation in mud pots, Yellowstone Park, Wyoming, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 409–422, illus., tables, 1967.

Kaolinitic, montmorillonitic, illitic, and mixed layer clay minerals are found in mud springs and mud pots of Yellowstone Park. A sequence of alteration is proposed as Phase I, alteration of bedrock and sediments by hot spring waters to produce three-layer clay minerals (including mixed-layer species) and kaolinite-group minerals; Phase II, further alteration to produce a mud composed predominantly of kaolinite and some form of silica.—Author's abstract

Drover, D. P. *See* Williams, B. G. 06182

06100 **Drugg, W. S.** Palynology of the upper Moreno Formation (Late Cretaceous-Paleocene), Escarpedo Canyon, California: Palaeontographica, ser. B, v. 120, nos. 1–4, p. 1–71, illus., 1967.

On the basis of palynological assemblages the Cretaceous-Tertiary boundary has been placed in the Dos Palos Shale Member about 20 feet above the Marca Shale Member. The upper Ciervian Stage (or B Zone) of Goudkoff's 1945 zonation of the Upper Cretaceous of the Great Valley of California has been placed in the Danian. *Trithyrodinium and Cassidium* are erected as new dinoflagellate genera and the genus *Membranosphaera* Samoilovitch ex Norris and Sarjeant is redefined. *Quadripollis* is erected as a new genus of dispersed pollen. Also described as new are 15 species of microplankton and 7 species of dispersed pollen grains. The spore-pollen assemblages suggest a warm-temperate to subtropical climate.—*from* Author's abstract

Duke, H. R. *See* Bittinger, M. W. 06115

06256 **Duncan, D. C.** Geologic setting of oil shale deposits and world prospects [with French and Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 659–667, illus., 1967.

The lithology, depositional environments, and world distribution of oil shale deposits are reviewed. Three principal lithologic types of oil shale are recognized: (1) carbonate-rich shale, (2) siliceous shale, and (3) cannel shale. Major oil shale deposits were formed in large lakes and in marine platforms and shelf areas. Numerous smaller deposits were formed in open bodies of water near coal-forming swamps. World distribution of deposits formed at different geologic intervals is illustrated in a series of five maps. The major older deposits were formed mostly in marine platforms and most are low grade. Most of the large younger deposits were formed in large lakes and marine basins that deepened during accumulation of the shale in regions near the world's Tertiary orogenic belts. Future exploration of little-prospected deposits will identify usable oil shale in many parts of the world.—Author's abstract

Dunning, Gail. *See* Gross, Eugene B. 06388

Dunphy, Gerald J. *See* Jordan, James N. 00201

Durfor, C. N. *See* Cohen, Philip. 06129

00357 **Eargle, D. Hoyle.** Nomenclature of formations of Claiborne Group, middle Eocene, coastal plain of Texas: U.S. Geol. Survey Bull. 1251-D, p. D1–D25, illus., 1968.

The outcropping Claiborne of Texas consists of alternating marine and nonmarine or near-shore sediments. The marine rocks are mostly glauconitic clay, the rest are blanket sands. Each formation can be traced hundreds of miles laterally and

tens of miles down dip. The sequence and lithology are different in the Rio Grande Basin, however. Details of correlation and nomenclature are discussed.—HRC

Eaton, Jerry P. *See* Bateman, Paul C. 06158

Eberhardt, P. *See* Bogard, D. 00314

Eckroad, S. W. *See* Aronson, J. R. 06366

06065 **Eddy, Gerald E.** Subsurface disposal of industrial wastes—Progress report: Interstate Oil Compact Comm. Comm. Bull., v. 9, no. 2, p. 71–79, 1967.

The report is divided into four parts: (1) a short discussion of pollution problems in general with information on the nature and seriousness of the pollutants and the treatment methods currently being used, (2) problems and conflicts of use of underground reservoirs as they may affect other values and uses of these reservoirs for other reasonable purposes, (3) a summary coverage of disposal systems and disposal wells now in use in the various states including comments on state policy regulations and enforcement, and (4) the establishment of guidelines which may be helpful to all states concerning initial processing of applications, drilling, monitoring, and final abandonment of disposal wells.—ESL

06101 **Eggert, Donald A.; Delevoryas, Theodore.** Studies of the Paleozoic ferns *Sermaya*, gen. nov. and its bearing on filicalean evolution in the Paleozoic: Palaeontographica, ser. B, v. 120, nos. 1–4, p. 169–180, illus., 1967.

The specimen, found on, and beneath the partially eroded surface of a coal ball from Berryville, Ill., consists of various frond remains, the two largest and most basal ones of which exhibit internal structure corresponding to the genus *Anachopteris*. The sporangia show evidences of having been arranged in simple, radial sori with few members and lacking stalks, had walls one cell layer thick at maturity, and were annulate with an incomplete horizontally oblique annulus composed of two rows of cells. Structure of the sporangia shows a remarkable similarity to that of the Gleicheniaceae; this structure, with *Anachoropteris*-type anatomy, has great evolutionary significance.—HRC

00369 **Eggler, D. H.; Larson, E. E.** Paleomagnetic study of dated Precambrian rocks of the Front Range, Colorado–Wyoming: Royal Astron. Soc. Geophys. Jour., v. 14, no. 5, p. 497–504, illus., table, 1968.

The mean direction of remanent magnetization, after partial a–c demagnetization, of Precambrian rocks from the Front Range of Colorado and Wyoming gives a paleomagnetic pole position of 8° N., 29° E. Rock types sampled include andesite dikes, diorite inclusions in granite, and a highly oxidized red granite, all with a radiogenic age of 1.41 b.y. This preliminary study suggests there are at least two and probably as many as four field reversals recorded in these rocks, and that remanent directions from andesite dikes may be useful in determining tectonic rotation of the Front Range.—Authors' summary

00304 **Egiazaroff, Ivan.** River-bed degradation below dams—Discussion [of paper 5335 by S. Komura and D. B. Simons, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 5825, Jour. Hydraulics Div., no. HY2, p. 597–598, 1968.

Paper 5335 [ibid., v. 93, no. HY4, p. 1–14, 1967] is a valuable approach to a difficult problem, but in the light of observations made by the writer with regard to the relation a_c/a_e and $U_* U_{*c}$ the investigation deserves further consideration.—ESL

06288 **Elliot, Charles L.** Some applications of seismic refraction techniques in mining exploration, *in* Seismic refraction prospecting (A. W. Musgrave, editor): Tulsa, Okla., Soc. Explor. Geophysicists, p. 522–538, illus., tables, 1967.

Application of seismic refraction techniques to selected complex mining exploration problems has been attempted using special procedures for operation and interpretation. In one area, the surface of an undulating bedrock under thickening cover was accurately derived on a point-by-point basis using actual raypath tracing

techniques by means of the angle of emergence of the raypaths at adjacent detectors. In another area, an experimental program resulted in the direct detection and delineation of a low-velocity massive sulfide body. This was accomplished by fan shooting using emergence angles and raypath tracings of the high-velocity rays that were diffracted by the boundaries of the body and using the time lag of the first arrivals of the direct raypaths that traversed the sulfide body.—Author's abstract

06066 **Elsasser, Walter M.** The Earth's magnetism, *in* The Earth in space (Hugh Odishaw, editor): New York and London, Basic Books, p. 77–87, 1967.

This is a semipopular account of the Earth's magnetic field; a description of the field, its applications to paleomagnetism, and the origin of the field are included. The dynamo theory is explained.—HRC

Emerson, William K. *See* Dance, S. Peter. 06035

Emslie, A. G. *See* Aronson, J. R. 06366

06037 **Enman, John A.; McClure, Lavere W.; Lauffer, James R.** Preparation of films for geology presentation: Pennsylvania Geographer, v. 5, no. 4, p. 10–14, illus., 1967.

When briefings on what is to be seen on field trips showed that students do not relate slides and transparencies with real situations, the Geography Department at Bloomsburg State College, Pa., began producing its own 8-mm color-sound films. The first one made treats the geology of the Valley and Ridge province in Columbia County, showing tilted strata long road cuts and in quarries. The techniques, equipment, and mistakes are described. Further films are planned.—ESL

06434 **Erdman, J. Gordon.** Geochemical origins of the low molecular weight hydrocarbon constituents of petroleum and natural gases [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 13–24, illus., tables, 1967.

The C_1–C_{10} hydrocarbons are the principal constituents of natural gas, natural gas liquids, and the volatile fraction of crude oils. Some of the hydrocarbons are synthesized by organisms. Most hydrocarbons stem from chemical degradation of many types of organic matter. Some of these reactions reach completion shortly after deposition, while others contribute only during the last stages of diagenesis. Temperature is the primary rate controlling factor, while pressure, inorganic reactants, and mineral catalysts are secondary. Hydrocarbon composition of the reservoir depends on source material, conditions of deposition and burial, and coincidence between stages of organic diagenesis and conditions favorable for accumulation.—*from* Author's abstract

Ergun, Sabri. *See* Bivins, Doris. 00377

Erickson, R. L. *See* Wells, J. D. 06274

06263 **Ertl, Tell.** Guides to prospecting for oil shales [with French and Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 717–718, 1967.

Guides to prospecting for oil shales will be summarized, based on the author's experience in investigating oil shale deposits in North America, South America, and Europe.—Author's abstract

00195 **Esmaili, Houshang; Scott, Verne H.** Unconfined aquifer characteristics and well flow: Am. Soc. Civil Engineers Proc., v. 94, paper 5872, Jour. Irrigation and Drainage Div., no. IR 1, p. 115–136, illus., tables, 1968.

Numerical solutions are developed for determination of aquifer characteristics and unsteady radial flow through injection wells in unconfined aquifers under constant drawdown and injection pressure conditions. These solutions are based on a numerical solution of the basic differential equation of flow. Appropriate

dimensionless parameters are introduced to transform the basic differential equation of flow into an explicit form. Dimensionless graphical solutions are presented for the rate and accumulative volume of discharge and recharge and the radius of expansion of recharge mounds versus time for a range of drawdown and injection pressure values. Numerical examples are presented by applying these solutions to hypothetical field conditions.—Authors' abstract

06036 **Evans, John W.** A re-interpretation of the sand pipes described by Adegoke: Veliger, v. 10, no. 2, p. 174–175, illus., 1967.

O. S. Adegoke (1966) described some silicified sand- and mud-filled pelecypod burrows from the upper Miocene Monterey Formation of San Luis Obispo County, Calif., tentatively assigning the fossil pholad to the genus *Chaceia*. The characters of the valves used by Adegoke to identify the genus are, however, not definitive, applying also to species of *Penitella* and other genera. Moreover, Adegoke describes two types of burrows: elongate conical, similar to those bored by most pholads; and small, spherical with or without short, slender necks. Evans has observed the latter type in one living Pacific coast species, *Nettastomella rostrata*, which is found in very soft shale. If the spherical burrows were formed by this species, this would be evidence that the now hard, cherty Monterey Formation was a soft shale when bored in late Miocene time.—VMJ

Ewing, G. N. *See* Loncarevic, B. D. 06401

06303 **Ezell, G. Dale.** Historical review of the development of a deep sea ocean bottom seismograph system, *in* The new thrust seaward—MTS Conf. and Exhibit, 3d Ann., San Diego, Calif., 1967, Trans.: Washington, D. C., Marine Technology Soc., p. 147–166, illus., 1967.

This paper describes an ocean bottom seismograph station which records three components of seismic activity simultaneously with minute variations in water pressure. Frequencies recorded are in the band 1 HZ to 10 HZ. Signal amplification is performed by specially designed low frequency parametric amplifiers with exceptionally low noise characteristics. A time code, derived from an accurate crystal oscillator and micrologic networks, is recorded with seismic and pressure signals.—Author's abstract

06415 **Fahlbusch, Volker.** Die Beziehungen zwischen einigen Cricetiden (Mamm., Rodentia) des nordamerikanischen und europäischen Jungtertiäers: Paläont. Zeitschr., v. 41, nos. 3–4, p. 154–164, illus., 1967.

Democricetedon is a well-known genus of European fossil rodent. It ranges from the lower middle Miocene to the lower Pliocene. *Copemys* from the United States is considered morphologically identical to *Democricetedon*. The American forms did not give rise to the European forms. Therefore, for the time being, the North American and European species of *Copemys* will be added to the Subfamily Cricetinae or the Tribe Cricetini.—*from* Author's summary

Falkenbach, Charles H. *See* Schultz, C. Bertrand. 06033

00325 **Fennah, R. G.** A new genus and species of Ricaniidae from Palaeocene deposits in North Dakota: Jour. Nat. History, v. 2, no. 1, p. 143–146, illus., 1968.

A new genus and species, *Cotradechites lithinus* Fennah, are proposed for a fossil tegmen of a ricaniid (Homoptera: Fulgoroidea) collected in clay deposits of latest Palaeocene age near Dickinson, North Dakota. The new genus is considered to be most nearly related to the modern tropical American genera *Cotrades* and *Semestra*.—Author's summary

06222 **Fenner, Peter.** Preliminary study of effects of illite comminution, *in* Internat. Clay Conf., Jerusalem, Israel, June 1966, Proc., V. 2: Jerusalem, Israel Program Sci. Translations, p. 241–243, illus., 1967.

Samples of illite from Fithian, Ill., were comminuted and prepared for X-ray diffraction by various means; nine tracings from the diffractometer output are

shown. Instrumental conditions were as nearly identical for all runs as possible. The various preparatory techniques are described briefly. Comminution was by mechanical grinding and ultrasonic disaggregation. X-ray mounts were pellet-type and clay-covered glass cover slips. The first and third order basal reflections are most consistent, but the profile of diffraction peaks is quite varied, and other peaks are capricious in their presence or absence. Gravity settled particles show the highest degree of surficial orientation, and the ultrasonic disaggregation techniques result in a more uniform grain-size distribution. More analytical data should accompany reports of clay investigations, and a Standards Committee is needed.—ESL

06209 **Ferguson, Carl C.** Mineral resources summary of the Beans Creek quadrangle, Tennessee (including the Tennessee portion of the Estill Fork quadrangle, Alabama-Tennessee): Nashville, Tenn., Tennessee Div. Geology, 6 p., 1967.

Mineral resources mined in the Beans Creek quadrangle are limestone, and possibly, coal. Five limestone formations—Warsaw, St. Louis, Monteagle, Bangor and units of the Pennington Formation—which crop out over most of the area, would be acceptable for most general uses. A one-inch coal seam was found in the Raccoon Mountain Formation; the coal is probably equivalent to one of the Bon Air coals. This text accompanies Tennessee Div. Geology Geol. Map GM 87-SW by R. G. Stearns and C. C. Ferguson (cited separately).—MCM

Ferguson, Carl C. *See* Stearns, Richard G. 06227

06087 **Ferguson, S. A.** MacLeod Mosher Gold Mines Limited surface geology—Parts of Errington and Ashmore Townships, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 435, scale 1 in. to 500 feet, text, 1967.

Oldest country rocks are metabasalts which are overlain by dacites of a tuff and breccia unit with associated iron formation, which in turn are overlain by metasediments. Intrusive rocks are feldspar porphyry, lamprophyre, and diabase. Regional strike is E-W; major folds are the Barton synclines, Talmora anticline, Mosher Lake syncline, Mosher Lake anticline, and the Hard Rock synclinorium. Orebodies of the quartz stringer zone type contain small amounts of metallic minerals (pyrite, chalcopyrite, arsenopyrite, gold), and gangue minerals (quartz, ankerite, calcite, tourmaline, scheelite). Refractory sulfide deposits consist of irregular masses within complexly folded iron-formation, with pyrite most abundant and with small amounts of arsenopyrite, pyrrhotite, sphalerite, and chalcopyrite.—MCM

06088 **Ferguson, S. A.** (compiler). MacLeod Mosher Gold Mines Limited subsurface plans and longitudinal projection—Parts of Errington and Ashmore Townships, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 436, scale 1 in. to 500 feet, 1967.

06089 **Ferguson, S. A.** (compiler). MacLeod Mosher Gold Mines Limited cross sections—Parts of Errington and Ashmore Townships, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 437, scale 1 in. to 500 feet, 1967.

00204 **Ferraes, Sergio G.** Statistical relation of magnitude to frequency of occurrence for earthquakes in Mexico City: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 449-452, illus., tables, 1967 [1968].

Two hundred forty quakes with a magnitude over 3.5 are studied. The formula $\log_{10}N = a^{-bM}$ first proposed by Gutenberg and Richter in 1944 is revised using a general exponential law, finite differences analysis, and the least squares method. It is found that the relationship between the magnitude and frequency of occurrence to describe the seismicity of central Mexico is approximately $\log_{10}N(M) = 4.54 - 0.55M$. Discussion of the results and another determination of b for Mexico and Central America given by Gutenberg and Richter suggest a real departure from the "constant b" hypothesis in the central Mexico seismic region, or that b varies systematically from one active seismic region to another.—*from* Author's abstract

06197 **Ferrell, Ray E., Jr.; Grim, Ralph E.** The influence of alkaline solutions on the alteration of the clay minerals, *in* Clays and clay minerals—Clay Minerals Conf.,

15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., . 27), p. 293–304, illus., 1967.

Samples of illite, illite—mixed-layered material, kaolinite, and two montmorillonites (smectites) were treated with NH_4OH solutions of pH 8.5, 9.5, 10.5, 11.5, and 12.5 for 6, 12, 24, 48, 72, and 96 hr at 60°C, and studied by one-dimensional structural analysis to determine effects of laboratory-controlled degradation. Analyses show an oscillatory change in the population of tetrahedral and octahedral structural sites which is consistent with a core-rind structural concept of clay minerals. Leaching of clay minerals takes place by the alternate growth of the rind and destruction of this frayed edge by agitation. The extent to which the rind develops is controlled by particle size, variability of chemical composition, and amount of agitation. The order of increasing development of the frayed edge is: kaolinite, illite, illite—mixed-layered material, and montmorillonite.—*from* Authors' abstract

06450 **Figueroa, S.; Coffin J.** New geophysical developments and methods in Mexico [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 757–763, 1967.

In Mexico's petroleum exploration, new geophysical methods and techniques have been put to use at the rate that these have been developed in other parts of the world. Exploration activity has been maintained on an up-to-date level without undue expense in costly experimental research. New sophisticated seismic techniques are being considered for their use in specific problems.—Authors' abstract

00352 **Fischer, William A.** EROS—Viewing the Earth from space: GeoScience News, v. 1, no. 3, p. 16–19, illus., 1968.

From the Gemini and Mercury program came images of the Earth, analogous to Ranger observations of the Moon, that can aid in regional classification of landforms and recognition of large subtle anomalies. They show that dynamic phenomena are observable from space, and that small scale images have value in resources planning. A photoimage map was compiled of a third of a million square miles in Peru, Bolivia, and Chile, and the features shown are discussed. Repeated coverage throughout the year should facilitate recognition of features such as low-level heat sources, shown by anomalous melt patterns in snow, that may reflect sources of geothermal energy or oxidizing orebodies. An observation satellite in orbit will allow study of the effects of earthquakes and volcanoes.—ESL

Fisher, George W. *See* Southwick, David L. 06327

06220 **Fleischer, Michael.** Fluoride content of ground water in the conterminous United States, *in* Relation of geology and trace elements to nutrition—A symposium, New York, 1963: Geol. Soc. America Spec. Paper 90, p. 65, illus., 1967.

A map shows the percentage of fluorine in ground water by county. In some areas, the ground waters have fluoride contents much higher than those suggested by the map. Examples are water from the Dakota Sandstone, sodium-bicarbonate waters in many places along the Atlantic and Gulf coasts, and water from dolomite-rich areas. The high F content could be due to leached volcanic rocks in the area.—*from* Author's abstract

00298 **Fleischer, R. L.; Price, P. B.; Walker, R. M.** Identification of Pu-244 fission tracks and the cooling of the parent body of the Toluca meteorite: Geochim. et Cosmochim. Acta, v. 32, no. 1, p. 21–31, illus., tables, 1968.

Fossil nuclear fission tracks have been studied in three silicate minerals from inclusions in the iron meteorite Toluca. If most of these tracks are assumed to be due to Pu-244, their densities relative to those from U-238 spontaneous fission give measures of the time intervals between the end of production of heavy elements that were condensed in the solar system and the times when the minerals reached temperatures below which fission tracks are permanently stored. These time intervals, together with track stability data, allow a cooling rate to be calculated of $1.1(+0.6, -0.5)$ °K per m.y. through the temperature interval 500–900°K, 4.6 b.y.

ago. The fission tracks are thus concluded to be due to Pu–244, the only known spontaneously fissioning isotope which would yield the observed concordant cooling rate.—*from* Authors' abstract

05992 **Foit, Franklin F., Jr.; Peacor, Donald R.** High temperature diffraction data on selected reflections of an andesine and anorthite [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 147–156, illus., 1967.

Selected maxima of classes *a*, *b*, and *c* of anorthite ($An_{98\pm1}$) and *a* and *e* of andesine ($An_{47\pm1}$) were studied as a function of temperature using a newly designed furnace for a Weissenberg counter diffractometer. The class *c* maxima in anorthite were no longer observable at temperatures above 285°C, whereas the *e* maxima in andesine persisted after 88 hours at 930° to 1000°C. The *e* maxima showed continual change over the temperature range 25° to 1070°C. Changes in all classes of maxima (*a*,*b*,*c*, and *e*) as a function of temperature were immediate and reversible.—Authors' abstract

06286 **Folinsbee, R. E.; Cumming, G. L.; Fritz, P. D.; Krouse, R. H.; Jackson, S. A.; Sasaki, A.; Singh, R. N.** Pine Point, N.W.T., Canada—A lead–zinc deposit formed from hydrothermal connate brines? [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B222, 1967.

Forbes, M. J., Jr. *See* Cardwell, G. T. 06392

Foster, J. H. *See* Opdyke, N. D. 05983

06170 **Franco, John J.** Effects of stages on scour along riverbanks [with French abs.], Paper A29 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 232–239, illus.; discussion, ibid., V. 5, p. 96–97, 1967.

Periodic surveys were made along several reaches of the Mississippi River through one high-water season to determine the effects of changes in river stages on depth of scour along concave riverbanks. The results have shown that scour or deposition can occur along riverbanks depending on the alignment and configuration of the channel upstream and downstream and river stages. In general, the depth of scour increases with increase in river stage but the alignment of the channel can be such that deposition occurs with rising stages. Also, the location of the point of maximum scour or deposition can change with change in stage. These results indicate how regulating and stabilizing structures can be affected by the change in stage. In rivers where the rate of change of stages is moderate, the depth of scour or deposition is more a function of the actual stage (elevation) and stage duration than of the rate of change.—Author's abstract

06248 **Frankel, J. J.** Forms and structures of intrusive basaltic rocks, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 63–102, illus., 1967.

Intrusive bodies of basaltic rock are classified into concordant injected bodies (sills, sheets, laccoliths, lopoliths, phacoliths), discordant injected bodies (dikes, cone sheets, ethmoliths) and subjacent bodies (batholiths, stocks, bosses). This classification is based on shape and relation to country rock, not on size. Also, any intrusive body may be simple (homogeneous or differentiated), multiple (formed by successive intrusions of the same magma), or composite (formed by successive intrusions of different magmas). Examples of all these types are described. Contact effects, including rheomorphism, are considered. It is pointed out that thin dikes often have wider aureoles than thick sheets because they acted as magma conduits over a long period of time. The mechanisms of intrusion of the various bodies are discussed.—AGM

06133 **Frankel, Richard J.** Economics of artificial recharge for municipal water supply [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 289–302, illus., tables, 1967.

Waste-water renovation through ground water recharge proved to be the most feasible solution to reclamation of the effluent of any type treatment plant today. Further study has evaluated chemical and physical limitations of artificial recharge using municipal wastes, economic trade-offs between additional treatment prior to recharge and greater land use, and the break-even point for land values as a function of economies of scale. The economics of a case-study in the arid West, and a proposed scheme for converting Washington, D.C., from surface water use to artificial recharge of undeveloped aquifers are discussed.—*from* Author's abstract

Franklin, Arley G. *See* Krizek, Raymond J. 06194

Freas, D. H. *See* Mossman, M. H. 06187

Freeman, P. S. *See* McBride, E. F. 00346

Freshney, Edward C. *See* Belt, Edward S. 06368

00171 **Friedman, Irving.** Hydration rind dates rhyolite flows: Science, v. 159, no. 3817, p. 878–880, illus., 1968.

Hydration of obsidian has been used to date rhyolite flows, containing obsidian or porphyritic glass, at Glass Mountain (Medicine Lake Highlands) and Mono Lake, California. The method is simple and rapid and can be used to date flows that erupted between 200 and approximately 200,000 years ago.—Author's abstract

06185 **Fripiat, J. J.; della Faille, M.** Surface properties and texture of chrysotiles, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 305–320, illus., tables, 1967.

Nitrogen surface areas and pore-size distribution curves of chrysotiles [Calif., Ariz., Canada, Russia, and Corsica] have been measured using a continuous flow method. A model founded on a hexagonal close packing of fibers has been adjusted to fit the frequency distribution of fiber outside diameters obtained from electron micrographs. From this model, theoretical distribution functions of the surface area vs. pore diameter were computed and compared with experimental data. Only in the Coalinga chrysotile do the computed and experimental data agree well enough to allow one to conclude that pores between and within fibers are free from any amorphous material. For the others the degree of filling of the pore system was always higher than 50 percent, and hydration water cannot be removed unless samples are pretreated at 300°C–400°C. Water is driven off from the Coalinga fibers at less than 100°C.—*from* Authors' abstract

Fritz, P. D. *See* Folinsbee, R. E. 06286

Fujisawa, Hideyuki. *See* Akimoto, Syun-iti. 00281

Fukuoka, Shoji. *See* Kikkawa, Hideo. 06174

Fullam, Timothy J. *See* Whetten, John T. 06310

Fuller, J. G. C. M. *See* Illing, L. V. 06399

Fuse, Kiyono. *See* Hayatsu, Ryoichi. 00294

Fyfe, W. S. *See* Bischoff, J. L. 00277

06159 **Galay, V. J.** Observed forms of bed roughness in an unstable gravel river [with French abs.], Paper A11 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 85–94, illus., tables; discussion, ibid., V. 5, p. 48–49, 1967.

Echo-sounder measurements on an unstable gravel river in Alberta, Canada, indicate that minor bed forms develop on the river bed during high flow conditions and high bed load transport. The wave length of these bed forms appears to decrease

with an increase in flow intensity and depth, for relatively small values of depth to grain size. Air photographs of this river reveal that the major bed forms (bars) are crescent-shaped with horns pointing downstream.—Author's abstract

06396 **Gammon, J. B.; Holland, H. D.; Borcsik, Maria.** Composition of an aqueous phase in equilibrium with melts of granitic composition [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B222–B223, 1967.

Garaycochea-Wittke, Isabel. *See* Buerger, M. J. 05984

00313 **Gard, Leonard M., Jr.** Bedrock geology of the Lake Tapps quadrangle, Pierce County, Washington: U.S. Geol. Survey Prof. Paper 388-B, p. B1–B33, illus., table, geol. map, 1968.

Bedrock in the Lake Tapps quadrangle consists of more than 11,000 feet of Eocene and Oligocene sedimentary and volcanic rocks of the Puget Group and Ohanapecosh Formations, intrusive rocks of probable Oligocene or Miocene age, and thin Miocene sedimentary deposits. The Puget Group is subdivided into the Carbonado, Northcraft, and Spiketon Formations. The Northcraft, a wedge of andesitic volcanic breccias, separates the coal-bearing arkosic Carbonado and Spiketon Formations. The Miocene deposits are probably equivalent to part of the Ellensburg Formation which lies east of the Cascade Range. During Oligocene time, Eocene and Oligocene strata were folded in a north-trending north-plunging anticline. This large anticline contains several smaller, tightly folded anticlines and synclines broken by high-angle reverse faults which parallel the fold axes.—LMG

06011 **Gartner, Stefan, Jr.** Nannofossil species related to *Cyclococcolithus leptoporus* (Murray and Blackman): Kansas Univ. Paleont. Contr. Paper 28, p. 1–4, illus., 1967.

Individual placoliths of the coccolithophore *Cyclococcolithus leptoporus* often break apart into two shields. The genera *Tiarolithus* (type species, *Calcidiscus medusoides*) and *Calcidiscus* (type species, *C. quadriforatus*) are based on species here recognized as representing isolated distal and proximal shields, respectively, of *Cyclococcolithus leptoporus*. *Tiarolithus*, and *Calcidiscus*, therefore, are junior (subjective) synonyms of *Cyclococcolithus*.—Author's abstract

06012 **Gartner, Stefan, Jr.** Calcareous nannofossils from Neogene of Trinidad, Jamaica, and Gulf of Mexico: Kansas Univ. Paleont. Contr. Paper 29, p. 1–7, illus., 1967.

Previous studies of Neogene calcareous nannofossils commonly have been restricted either to a limited interval of the Neogene or to particular groups among the calcareous nannofossils. Consequently, a number of species have not yet been described. Among these are 14 new species and 1 new subspecies described here from Trinidad, Jamaica, and the Gulf of Mexico.—Author's abstract

00168 **Gary, Samuel; McGregor, A. A.** Exploration philosophy behind the Bell Creek oil field discovery, Powder River County, Montana: Mtn. Geologist, v. 5, no. 1, p. 15–21, illus., 1968.

The Jewel and Rocky Point fields in Crook and Campbell Counties, Wyoming are located in the same position relative to the Black Hills monocline as other Minnelusa oil fields on trend to the south. Exploration following the Rocky Point development resulted in the discovery of oil in the Muddy Sandstone at the Black Bank field, Crook County, Wyoming. Ranch Creek field was also discovered in 1965 in Powder River County, Montana. Ultimately the exploration program led to the discovery of Bell Creek field in 1967.—*from* Authors' abstract

06242 **Gast, Paul W.** Isotope geochemistry of volcanic rocks, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 325–358, illus., tables, 1967.

Large igneous intrusions can be investigated by comparing oxygen isotope compositions of each. It may be possible to distinguish tholeiitic from alkali basalt

by lead-isotope composition, uranium, thorium, and lead contents. Both lead- and strontium-isotope compositions suggest that there are regions of the mantle whose composition varies from that of the primitive 4.5 b.y. old mantle; furthermore, data suggest that these regions may be over 1 b.y. old. Present day continents are not necessarily chemically related to the mantle now underlying them. Conversely, in the static-mantle or continental-root theory, the subcontinental mantle and the overlying continents may be chemical complements. Such are the continental drift versus nondrift theories; isotopes could resolve this.—*from* Author's summary

06098 **Gates, Robert M.; Martin, Charles W.** The bedrock geology of the Waterbury quadrangle (with map): Connecticut Geol. and Nat. History Survey Quad. Rept. 22, 36 p., illus., tables, geol. map, 1967.

The Waterbury gneiss dome is the southernmost of a series extending from Chester, Vt., along the eastern flank of the Green Mtn. synclinorium. The Waterbury Formation forms the core, a complexly folded metasedimentary gneiss with migmatitic granite-trondjemite mixtures. Except for the unroofed western side, the core is mantled by three units of isoclinally folded Hartland Formation: Unit I, Hitchcock Lake Member, and Straits Schist Member. A fourth unit, Southington Mtn. Member, limited in extent, has thin layers of mica-poor granulite. The mineral assemblages of both formations are described. Intrusive rocks are ubiquitous, but not always mappable. Refolding of the Hartland Formation, probably in Acadian time, was controlled by the resistant, buttressing Waterbury Formation or by rising, partly melted "domes" in the formation.—GDC

Gaydos, M. W. *See* Cardwell, G. T. 06392

06071 **Geller, S.** Crystal chemistry of the garnets [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 1-47, illus., tables, 1967.

Garnet structure has become increasingly important in the last ten years. During this period a number of structure refinements have been carried out; these are reviewed and some consequences of the results are discussed. A survey has been made of all cations which enter the garnet structure; site preferences are given. Many examples of garnets and garnet systems investigated are listed, some for the first time. Ionic site preference is discussed; relative ionic size is of primary importance, but for ions like Cr^{3+} and Mn^{3+}, the electronic configuration is also important. The Co^{2+} ion much prefers the octahedral site to the tetrahedral. Garnets have been prepared with the Co^{3+} ion in both tetrahedral and octahedral sites. Determination of ion distribution in the system $Y_3Fe_{5-x}Ga_xO_{12}$ by different techniques is reviewed.—*from* Author's abstract

06093 **George, P. T.** (compiler). Aeromagnetic-geological compilation of the Operation Kapuskasing area: Ontario Dept. Mines Geol. Map P. 420, scale 1 in. to 16 mi., text [1967?].

As much of this area in northeastern Ontario has a thick overburden cover, considerable use was made of regional aeromagnetic maps in conjunction with geological data to interpret structural relations between various rock units. Bedrock ranges from early Precambrian to Cenozoic; unconsolidated deposits mantle most of the area. There is a distinct anomaly in regional structure, folding is complex, and faulting occurs along two main strike trends. The most striking feature of the aeromagnetic map is the northeast-trending anomaly from James Bay to Fraserdale where it dips out abruptly, resumes again south of Kapuskasing, and can be traced about 100 miles further to the southwest. The extreme, linear, magnetic highs within the anomalous zone correlate closely with magnetite-bearing, mylonite fault zones. Wilson and Brisbin (1965) interpreted the gravity anomaly as indicating a pronounced upwarp in the Conrad discontinuity.—MCM

06047 **Geyer, Vernon R., Jr.** Magnetic survey of Carroll and Ross sulphide prospect, York County, South Carolina: South Carolina Div. Geology Geol. Notes, v. 11, no. 4, p. 59-65, illus., table, 1967.

During June 1966 a ground magnetometer survey was made on a portion of the Carroll and Ross property in York County to determine the magnetic expression

over a sulfide outcrop near Wolf Creek. Over 100 readings were taken with a vertical component torsion magnetometer at stations on a 700′×900′ grid. Though a magnetic anomaly is clearly indicated in the grid area no attempt to explain the significance of it is made in this report.—Author's abstract

06070 **Ghose, Subrata; Hafner, Stefan.** Mg^{2+}–Fe^{2+} distribution in metamorphic and volcanic orthopyroxenes [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 157–162, illus., tables, 1967.

Mg^{2+}–Fe^{2+} distribution and site-occupancy factors at the M_1 and M_2 sites of orthopyroxenes from high-grade metamorphic rocks (granulites) in Greenland and Sweden, as well as volcanic orthopyroxenes from Japan and the Dominican Islands, have been determined from the hyperfine splitting of ^{57}Fe spectra using the Mössbauer technique. The degree of Mg^{2+}–Fe^{2+} order in the metamorphic pyroxenes is higher than that in the volcanic pyroxenes. Equilbrium constants have been estimated, assuming the ideal-solution model for each site.—Authors' abstract

00287 **Giardini, A. A.; Lakner, J. F.; Stephens, D. R.; Stranberg, H. D.** Triaxial compression data on nuclear explosion shocked, mechanically shocked, and normal granodiorite from the Nevada Test Site: Jour. Geophys. Research, v. 73, no. 4, p. 1305–1320, illus., tables, 1968.

Compression tests were made on samples of granodiorite collected before the Hardhat detonation at 195-, 225-, and 255-m depths. Post-detonation rock was sampled at 23 and 27.5 m from ground zero (calculated peak shock pressure about 20 kb). Pre-detonation specimens from 195 m were mechanically shocked in the laboratory (35–40 kb). The failure of granodiorite under compressional stresses was adequately described by a modified Coulomb maximum shear stress theory. Under uniaxial compression failure was brittle shear, under triaxial compression quiet slip at low confining pressures, and under high compression brittle shear. Under confining pressures shock effects disappeared rapidly, behavior becoming normal at 4.5 kb. Young's modulus was $0.64 \pm 0.26 \times 10^6$ bars for unshocked, 0.18×10^6 bars for nuclear-shocked, and 0.01×10^{-6} for mechanically shocked rock.—DBV

00175 **Giessen, Bill C.; Gordon, Glen E.** X-ray diffraction—New high-speed technique based on X-ray spectrography: Science, v. 159, no. 3818, p. 973–975, illus., 1968.

A method has been developed for obtaining lattice spacings of powder samples by X-ray diffraction in times potentially as short as 1 second. The sample is irradiated with polychromatic radiation from an X-ray tube, and the energy spectrum of X-rays scattered at a given angle is observed with a semiconductor radiation detector, coupled with a pulse-height analyzer.—Authors' abstract

00334 **Gildersleeve, Benjamin.** Geologic map of the Quality quadrangle, Butler and Logan Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-673, scale 1:24,000, section, text, 1968.

Oil, principal exploited resource in the Quality quadrangle, is produced from the Tar Springs (Mt. Zion pool), and Hardinsburg Sandstone. Production has declined in recent years and as of 1965 the wells averaged only 2 bbl a day. Limestone has been quarried from the Glen Dean and Menard Limestones; although much could be used for crushed stone and agricultural limestone, quarrying conditions are not favorable for commercial exploitation.—MCM

00302 **Gill, Mohammad Akram.** River-bed degradation below dams—Discussion [of paper 5335 by S. Komura and D. B. Simons, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 5825, Jour. Hydraulics Div., no. HY2, p. 593–595, 1968.

In discussing paper 5335 [ibid., v. 93, no. HY4, p. 1–14, 1967], the writer gives results of analytical study of the Brown-Einstein and Brown-Kalinske formulas.—ESL

Gnirk, P. F. *See* Cheatham, J. M., Jr. 06250

Goddard, John. *See* Broecker, Wallace S. 00211

00183 **Godfrey, L. M.; Stewart, J. D.; Schweiger, F.** Application of Dinoseis in Canada: Geophysics, v. 33, no. 1, p. 65–77, illus., 1968.

An experimental program was conducted to determine if a seismic system consisting of a Dinoseis, a digital recorder, and digital processing was adequate for solving exploration problems in Alberta and Saskatchewan. Aspects to be considered when using a low power, low frequency, surface source are: ambient and coherent noise reduction, resolution of reflected events, and penetration of subsurface. Field procedures and processing techniques used to attack these problems include stacking of multiple pulses taken at each shotpoint, selection of appropriate source and receiver arrays, common-depth-point coverage, and application of deconvolution and velocity and frequency filtering in the processing sequence. A match was obtained between central Saskatchewan Dinoseis traces and a synthetic seismogram over a frequency band width of 20–65 cps. Dinoseis sections were comparable to processed dynamite sections in two Alberta areas.—KAS

06358 **Goodell, H. Grant.** The sediments and sedimentary geochemistry of the southeastern Atlantic shelf: Jour. Geology, v. 75, no. 6, p. 665–692, illus., tables, 1967.

Sediment and geochemical data from the southeastern Atlantic shelf display variability that can be resolved through multiple nonlinear regression. Shelf sediments are composed chiefly of sand-sized quartz and mollusk shell debris. Outer shelf, slope and rise are floored with foraminiferal oozes, pteropod tests, bryozoan and coraline algal fragments, and terrestrial silt and clay. Regression surfaces representing the texture and mineralogy of the sediments are, in general, linear, with the planes striking parallel to the Georgia–Carolinas coasts, whereas regression surfaces representing the geochemical characteristics are largely quadratic, following the re-entrant in the coast and shelf. The geometry and geomorphology of the shelf and shore appear to be controlling regional textural, mineralogical and geochemical relationships.—*from* Author's abstract

Goodman, Richard E. *See* Cadman, John D. 06322

Gordon, Glen E. *See* Giessen, Bill C. 00175

00212 **Gradsztajn, Eli; Salome, Michel; Yaniv, Akiva; Bernas, René.** Isotopic analysis of lithium in the Holbrook meteorite and in terrestrial samples with a sputtering ion source mass spectrometer: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 387–393, illus., tables, 1967 [1968].

The isotopic composition and the distribution of lithium have been studied in the Holbrook meteorite, in granite, and in hornblende, using a sputtering ion source mass spectrometer of our own design. In granite and in hornblende, the isotopic ratios obtained for all points of the surface which have been investigated remain 12.0 within a ±2 percent uncertainty (uncorrected for mass discrimination). With exactly the same technique, the ratios obtained in Holbrook show fluctuations of about ±10 percent around an average of 12.0.—Authors' abstract

Graf, Donald L. *See* Blyth, Colin R. 06372

06359 **Graham, Joseph J.; Clark, Dana K.** Notes on the types of California species of the foraminiferal genus *Orthokarstenia* Dietrich, 1935, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 91, p. 55–60, illus., 1967.

Micropaleontologists are confused over diagnostic features of several Late Cretaceous representatives of this elongate calcareous genus previously recorded as taxa of *Siphogenerinoides* Cushman, 1927. Description and illustrations particularly of *S. clarki* and *S. whitei* or *S. clarki* var. *costifera* from Contra Costa and Fresno Counties, classified now as orthokarstenids, in part at least, are seemingly inadequate and subject to various interpretations. From a restudy of type specimens of these ancient protozoans, *S. clarki* appears to be restricted to the youngest (Maestrichtian)

stage in California. It is evidence that faunal provinces like those in the Great Valley of California apparently existed then as far south as Peru, or earlier in West Africa.—GDC

06111 **Granquist, W. T.; Kennedy, J. V.** Sorption of water at high temperatures on certain clay mineral surfaces—Correlation with lattice fluoride, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 103–117, illus., tables, 1967.

The sorption of water, at 490°C and ca. 23–24 torr, on clay mineral surfaces has been studied using thermogravimetry and infrared absorption spectroscopy. Results from a series of synthetic hectorites, with and without lattice fluoride (see Granquist and Pollack, 1960), point to the presence of F^- in the clay lattice as an important condition for the sorption. Similar studies on natural hectorite and montmorillonite, synthetic interstratified montmorillonite/mica with and without fluoride, and Al_2F_6 support this interpretation of the role of the F^- ion and show that dioctahedral 2:1 clays sorb more water at 490°C than do trioctahedral 2:1 clays. The infrared spectra demonstrate that the sorbed water is for the most part hydrogen bonded to the surface.—Authors' abstract

Gray, Helen. *See* Musgrave, A. W. 06287

06239 **Green, D. H.** Effects of high pressure on basaltic rock, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 401–443, illus., tables, 1967.

It is shown that, in natural rocks, at 1100°C, a pressure of at least 23 kb is required to produce garnet+omphacite+quartz (eclogite) from basaltic rocks, eclogite being defined by the absence of plagioclase and by the ratio of jadeite/Tschermak's silicate being greater than 1:2. The transition from a gabbroic to an eclogite mineral assemblage occurs via an intermediate assemblage of garnet+plagioclase+pyroxene. The pressure at which garnet first appears is lower in an undersaturated (olivine-bearing) than in a saturated basalt; this may provide a criterion for subdividing the granulite facies of metamorphism. An important effect is the elimination of olivine as a liquidus phase in basalts from quartz tholeiite to alkali-olivine basalt in composition.—AGM

00166 **Green, Trevor H.; Ringwood, A. E.** Crystallization of basalt and andesite under high pressure hydrous conditions: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 481–489, tables, 1967 [1968].

Crystallization of synthetic high-alumina quartz tholeiite and basalt andesite glasses at 9–10 kb under conditions of $P_{water} < P_{load}$ demonstrates that subsilicic clinopyroxene, orthopyroxene, and amphibole are the near-liquidus phases above 1000°C. Amphibole is the dominant phase at about 960°C and less. Calcic plagioclase occurs nearer the solidus. In an andesite composition plagioclase and clinopyroxene are the near-liquidus phases at 940°C, joined by orthopyroxene, amphibole, and garnet at lower temperatures. The liquid fractionate follows the calc-alkaline trend and shows that the calc-alkaline igneous rocks may be derived by fractional crystallization of basalt under hydrous conditions at 30–40 km depth ($P_{water} < P_{load}$) or alternatively by the partial melting of amphibolite.—*from* Authors' abstract

00210 **Greer, David M.; Moorhouse, Douglas C.** Engineering-geologic studies for sewer projects: Am. Soc. Civil Engineers Proc., v. 94, paper 5780, Jour. Sanitary Eng. Div., no. SA1, p. 21–30, illus., 1968.

Realization by design engineers that the data presented in test boring logs are often insufficient for accurate estimates and economical designs has led to preparation of more complete engineering-geologic studies for sewer projects. Such studies usually involve a preliminary or planning phase report, followed, if the project is authorized, by a design phase study. These studies involve not only boring logs and test pits, but consideration of geologic factors, the techniques of geophysics

and soil laboratory testing, and the use of judgment and experience in discussing the effects of ground conditions, as indicated by all of the data, on the proposed design and construction. Part of the report is presented as an engineering soil map of the project area, and part in the form of a discussion of each soil or rock type mapped and its effect on design and construction.—Authors' abstract

Greggs, R. G. *See* Aitken, J. D. 06140

00365 **Gregory, Gardiner E.** Black Mountain quarries of Rumford, Maine: Gems and Minerals, no. 366, p. 32–34, illus., 1968.

On Black Mountain are quartz–mica schist, impure micaceous quartzite, thin bedded pyritiferous quartzite with shale partings, and quartz monzonite enclosing pegmatites of various shapes. Three stages of mineralization—primary, pneumatolytic and hydrothermal—are believed to have resulted in the present minerals, which include some rare phosphates, fine-grained lilac lepidolite, and rubellite fans, among others. In one location some 65 minerals have been found. The quarries have been worked for scrap mica, beryl, spodumene, lepidolite, and feldspar. Beryl, now of prime interest to collectors, is associated with cleavelandite, quartz, and yellowish wedge muscovite, concentrated in the wall-zone of pegmatite bodies; crystal sizes vary in diameter from 1/4 in. to 24 in., many tapered at one end.—GDC

06046 **Griffin, Villard S., Jr.** Folding styles and migmatization within the Inner Piedmont belt in portions of Anderson, Oconee, and Pickens Counties, South Carolina: South Carolina Div. Geology Geol. Notes, v. 11, no. 3, p. 37–52, illus., 1967.

Recumbent isoclinal folding is probably the major fold style in the Inner Piedmont of western South Carolina. Secondary upright folds of small amplitude are superimposed on the primary folds. Reverse faulting of minor displacement occurs to a lesser extent. The structural and stratigraphic picture is complicated by igneous-like emplacements of acidic rock. These emplacements have the characteristics of migmatites, pegmatites, and intrusives. The geomushroom hypothesis of Haller is favored at present as the best explanation for the association of subhorizontal foliation, highrank metamorphites, migmatites, and pegmatites.—Author's abstract

00316 **Griffin, W. L.; Murthy, V. Rama; Phinney, W. C.** K/Rb in amphiboles and amphibolites from northeastern Minnesota: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 367–370, illus., tables, 1967 [1968].

Six amphiboles were studied from the Ely Greenstone and the Knife Lake Series host rocks, along a ten mile metamorphic gradient in the Vermillion Range. Results suggest that the grade of metamorphism does not systematically affect the K–Rb ratios up to at least the amphibolite grade, and that the behavior of trace elements is different in the para- and ortho-amphibolites even though the mineralogy is similar. Also, the packing index may not be related to the metamorphic grade. The correlation of the K–Rb with the packing index may be due to the coupling of Al^{4} substitution with the incorporation of alkali elements into the A sites in amphiboles.—HRC

06293 **Griffith, J. W.** The uranium industry—Its history, technology and prospects: Canada Dept. Energy, Mines and Resources Mineral Resources Div. Mineral Rept. 12, 335 p., illus., tables, 1967.

Canada, with 37 percent of the Free World's uranium resources, rapidly became a leading producer after World War II; the value of its U_3O_8 produced in 1958 and 1959 exceeded that of any other Canadian-produced metal, and ranked fourth in exports. The subsequent decline has been almost as rapid, down to only four producing mines in 1964; with large surpluses in the United States and Britain, new demand for use as nuclear fuel is unlikely before 1970. Part 1 of this book reviews this history, and deals also with world resources and production, including short descriptions of uranium mining industries in the United States, South Africa, France, and Australia. Part 2 describes 28 properties of Canadian producers, with emphasis on history, geology, mining methods, and ore treatment.—GDC

Griffiths, J. C. *See* Dahlberg, E. C. 06374

06454 **Griffiths, John C.** Mathematical exploration strategy and decision-making [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 599-604, illus., 1967.

A program is proposed to cover the entire United States on a 20-mile grid by wells 15,000 feet deep; about 7,500 wells would be required. It is calculated that, on the basis of probability, at least five very large hydrocarbon or mineral deposits would be found by this method, and the project would pay off. In any case the information gained would be stimulating and valuable for conventional exploration.—KAR

Grim, Ralph E. *See* Ferrell, Ray E., Jr. 06197

06388 **Gross, Eugene B.; Chesterman, Charles W.; Dunning, Gail; Cooper, Joseph F.** Mineralogy of the Kalkar quarry, Santa Cruz, California, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 92, p. 3-10, illus., table, 1967.

Rare and unusual minerals have been found in the Kalkar quarry at Santa Cruz, in a massive recrystallized limestone which contains lenslike strata of calc-silicate rocks, probably in the Spur Series of pre-Cretaceous age. Over 50 minerals are listed and various assemblages described briefly. Mineralization is believed to result from emplacement of a plutonic body. Some polymetallic sulfides in the contact metamorphic deposit show paragenetic relationships in an overlapping sequence indicating earliest temperatures over 600°C. The order appears to be: recrystallization in the limestone with forsterite, diopside, and phlogopite in the calc-silicate rocks; sulfides and sulfosalts related to metasomatism following metamorphism, probably at temperatures below 530°C; and near-surface oxidation of sulfides and sulfosalts, accelerated in areas adjacent to faults.—GDC

06296 **Gross, G. A.** Geology of iron deposits in Canada—V. 2, Iron deposits in the Appalachian and Grenville regions of Canada [with French abs.]: Canada Geol. Survey Econ. Geology Rept. 22, v. 2, 111 p., illus., tables, geol. maps, 1967.

Nearly every known type of iron occurrence is included in the 200 deposits described here. Mined for over 70 years, the Clinton type formations at Wabana, Newfoundland, are the principal source in the Appalachian region; other such formations in Nova Scotia and Algoma type in New Brunswick are potential sources. In the Grenville region magnetite deposits predominate, with a few small iron formations in the southern part; ilmenite occurs as injected and disseminated masses in anorthosite; titaniferous-magnetite deposits are syngenetic in gabbroic rocks; magnetite with less than one percent TiO_2 occurs as replacement masses in metasediments. A close genetic relationship between various intrusions on the one hand, and replacement magnetite on the other, is indicated by their spatial relations and by variations in iron-titanium ratios with different host rocks.—GDC

06094 **Grundy, H. D.; Brown, W. L.** Preliminary single-crystal study of the lattice angles of triclinic feldspars at temperatures up to 1200°C: Schweizer. Mineralog. u. Petrog. Mitt., v. 47, no. 1, p. 21-30, illus., tables, 1967.

The reciprocal lattice angles of six plagioclases and a maximum microcline were measured at a series of temperatures up to 1200°C on a Buerger precession camera. The crystals were mounted by sintering on a thermocouple without cement and heated in a gas flame. The angles of the plagioclases change smoothly with temperature, α changing most and β least; the angles of microcline do not change with temperature. Plots of the change of α against γ for a sequence of temperatures are straight lines; the effect of heat on these angles for low and high albite is similar to the effect of the substitution of potassium on the angles measured at room temperature.—Authors' abstract

Gualtieri, James L. *See* Sharp, William N. 00355

06201 **Gude, Arthur J., 3d.; Sheppard, Richard A.** Composition and genesis of analcime in the Barstow Formation, San Bernardino County, California [abs.], *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 180, 1967.

Guilbert, John M. *See* Sloane, Richard L. 06118

05993 **Güven, Necip; Burnham, Charles W.** The crystal structure of 3*T* muscovite [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 163–183, illus., tables, 1967.

The structure of a three-layer trigonal muscovite from Sultan Basin, Snohomish County, Wash., has been determined and refined by least-squares methods using single-crystal counter intensity data as trigonal, space group $P3_112$ (or $P3_212$) with cell dimensions: $a=5.1963\pm0.0004$ A, $c=29.9705\pm0.0016$ A. The differences between this form and common $2M_1$ muscovite consist of: substitutional order-disorder of the tetrahedral and octahedral cations, and the distortions in the two structures. The single mica layer of 3*T* has space group *C*2, whereas the corresponding layer of $2M_1$ has space group $C\bar{1}$; hence these layers are not equivalent, and it is suggested that these forms not be termed polytypes, but polymorphs with derivative single layers.—ESL

Guy, H. P. *See* Rathbun, R. E. 06169

06438 **Guzmán, Eduardo J.** Reef type stratigraphic traps in Mexico [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 461–470, illus., 1967.

Reef facies of middle Cretaceous carbonates, Mexico's principal oil producing formations, occur in the Tampico embayment as two parallel belts known as the Golden Lane and Poza Rica trends; their cumulative production and reserves are 4.9 billion bbl of oil. Offshore seismic work and experience on land have shown that the Golden Lane reef is a closed oval shaped atoll with its eastern half extending in the subsurface under the Gulf of Mexico. The Poza Rica Trend, which will ultimately produce more oil than the Golden Lane, extends parallel to the reef and is a series of combined stratigraphic and structural traps.—*from* Author's abstract

Haarr, Allan P. *See* Black, Herbert L. 06224

Hadley, Jarvis B. *See* King, Philip B. 00263

Haefner, Karl. *See* Jagodzinski, Heinz. 05994

Hafner, Stefan. *See* Ghose, Subrata. 06070

06320 **Hagood, Allen.** This is Zion—An interpretation of a colorful landscape in picture and story: Springdale, Utah, Zion Nat. History Assoc., 72 p., illus., 1967.

Color and black-and-white photographs illustrate a visitors guide for general appreciation of the scenery of Zion National Park, Utah, as outlined in part one, and for the geological story (part two), which contains sections on: the layered rocks of Zion; Zion, a restless land; erosion destroys the land; and fulfillment of a cycle.—ESL

06291 **Haldane, J. B. S.** The origin of life, *in* The origin of life, by J. D. Bernal, App. I: Cleveland, Ohio, and New York, World Publishing Co., p. 242–249, reprinted 1967; originally published 1929.

Contributions of Pasteur, Darwin, and d'Herelle to theories on the origin of life are described. The role of bacteria, bacteriophage, and genes leads to speculations on life origin. The ideas of existence of intermediate forms and an atmosphere without oxygen allowing ultraviolet light to reach the Earth are brought together here for the first time. Comments by Bernal accompany the paper.—ESL

06055 **Hales, Anton L.** The core and the mantle, *in* The Earth in space (Hugh Odishaw, editor): New York and London, Basic Books, p. 59–67, 1967.

The structure and composition of the core and mantle of the Earth are discussed as determined from seismic, heat flow, and meteorite studies; from field studies of the crustal rocks; and from laboratory experiments at high pressures and temperatures.—VSN

Hall, Homer K. *See* Banta, James E. 06213

06062 **Hall, John W.** Two new species of *Ariadnaesporites* [with French abs.]: Pollen et Spores, v. 9, no. 3, p. 563–568, illus., 1967.

Ariadnaesporites intermedius n.sp. is described from the Upper Cretaceous (Turonian) Magothy Formation at Bethel, Md.; *A. fluviatilis* n.sp. is described from the Colgate Member of the Fox Hills Sandstone (Maestrichtian) in Dawson County, Mont., extending the stratigraphic range of the genus upward. These are added to the eight species of the genus described by L. V. Hills (ibid., p. 553–562). A study of ranges in body diameters of spores of all 10 species reveals that in the two species that appear to have associated megaspores and microspores the two kinds of spores are structurally similar. If interpretation of the smaller spores as microspores is correct, *Ariadnaesporites* is the only known marsileaceous fern spore genus having microspores not of the *Crybelosporites* type.—VMJ

06278 **Hall, W. E.** Genesis of the southern Illinois fluorite–zinc district as viewed from fluid inclusion and light stable isotope studies [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B224, 1967.

06309 **Hamelin, Louis-Edmond; Cook, Frank A.** Le périglaciaire par l'image—Illustrated glossary of periglacial phenomena—Travaux et Documents du Centre d'Études Nordiques 4: Quebec, Quebec, Les Presses de l'Université Laval, 237 p., illus., 1967.

This publication is a bilingual monograph which is not a French–English translation, so that while there is general agreement, differences between the texts reflect differences of opinion between the authors. The glossary is divided into three parts: Pt. 1 discusses ground ice, congelifraction, nivation, and floating ice forms; Pt. 2, running water and wind action in a periglacial environment; Pt. 3, patterned ground, solifluction, and cryoturbation. These nine chapters are each divided into several sections treating individual active or fossil phenomena, with illustrative material and brief discussions. A 395-item bibliography, and an index of periglacial phenomena are included.—ESL

06178 **Hamid, A.; Warkentin, B. P.** Retention of I-131 used as a tracer in water-movement studies: Soil Sci., v. 104, no. 4, p. 279–282, illus., 1967.

Iodine-131 is adsorbed on the clay particles; this could be prevented by keeping the pH above 7 or by adding a stable iodide salt. Iodine-131 can be used in acid soils only in the presence of stable I^- carrier.—JWH

06231 **Hamilton, D. L.; Anderson, G. M.** Effects of water and oxygen pressures on the crystallization of basaltic magmas, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 445–482, illus., 1967.

Fractional crystallization of a basaltic melt at constant high P_{oxygen} values can produce liquids enriched in SiO_2 and a trend very similar to that shown by typical calc-alkaline rock series. In contrast, constant composition fractional crystallization must lead to iron enrichment and slight silica depletion. The ambiguity in correlating these two trends of synthetic systems with those of natural rocks is pointed out. The presence of more than 1 percent by weight of water in the differentiating melt would be of importance in controlling P_{oxygen} but even so, the probability of attaining conditions of constant P_{oxygen} in natural situations is small. Also, it is uncertain that magmas contain so much water at depth. Most basalts have less than 0.5 wt percent water.—AGM

Hamilton, John C. *See* Sainsbury, C. L. 06362

06371 **Hamilton, N.** The effect of magnetic and hydrodynamic control on the susceptibility anisotropy of redeposited silt: Jour. Geology, v. 75, no. 6, p. 738–743, illus., 1967.

Directions of maximum susceptibility of 5 out of 7 silts deposited in a controlled flume averaged within 10° of the direction of water flow. Those for the remaining two (somewhat finer silts at lower velocities) diverged 15.5° and 17° respectively, both towards magnetic north. It is concluded that the Earth's field is a significant orienting factor only for very small grains and at low applied fluid stress.—REW

00321 **Hamilton, W. L.; Langway, C. C., Jr.** A correlation of microparticle concentrations with oxygen isotope ratios in 700 year old Greenland ice: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 363–366, illus., table, 1967 [1968].

A 1.29 m continuous vertical ice core from 300 m depth at site 2 was analyzed for O-18:O-16 ratios and microparticle concentration. Both sets of data showed 4 cyclic variations vertically. Average wave lengths of the cycles were $\geq$35.3 and 36.0 cm ice for O-18:O-16 and particle concentration respectively. Average volume concentration of microparticles in mid-winter precipitations, about 6×10^{-6}, was six times greater than the average found over the rest of the year. Peak dust concentrations occurred 4 cm higher (later) than the isotope ratio minima. This phase lag amounts to about 6 weeks. Dust concentration data were also used to calculate an upper limit for atmospheric fallout for this time and place of 2×10^{-6} gm cm^{-2} yr^{-1}.—*from* Authors' abstract

00343 **Hansen, R. O.; Stout, Perry R.** Isotropic distributions of uranium and thorium in soils: Soil Sci., v. 105, no. 1, p. 44–50, tables, 1968.

Thorium concentrations are higher than uranium in the B horizons, but in the upper horizons of the upland primary soils, uranium concentrations increase. There are instances where U and Th become separated as a result of the soil forming processes, such as movement of U into lime nodules or Th into organic complexes. In these instances, measurements of decay and of accumulation of Th-230 can give clues to the rate of soil-forming processes and aid in determining the soil age.—JWH

Hansen, W. R. *See* Olson, J. C. 00374

06004 **Hansen, Wallace R.** The Alaska earthquake of 1964: Nature, v. 215, no. 5099, p. 348–351, illus., 1967.

The effects of the Alaska earthquake of March 27, 1964, on the activities of man and on the wild life of the State are assessed. The earthquake disrupted the economy of the entire State, and total property damage exceeded 311 million dollars. Overall, landslides probably caused the most damage, but sea waves caused more of the 130 deaths than all other factors combined. The geophysical effects are summarized. Biological effects included wholesale extermination of marine organisms following crustal changes altering the ecology of the shore, salt water inundation of areas that had provided nesting grounds for migratory birds and winter forage for moose, and destruction to salmon spawning grounds. The full biologic impact will probably not be known for many years. Atmospheric effects, including sub-audible sound waves, were recorded far from Alaska, and caused substantial oscillations in the ionosphere.—DBV

06018 **Hanson, G. N.; Himmelberg, G. R.** Ages of mafic dikes near Granite Falls, Minnesota: Geol. Soc. America Bull., v. 78, no. 11, p. 1429–1432, illus., table, 1967.

Tholeiitic diabase, hornblende andesite, and olivine diabase dikes cut Precambrian gneissic rocks in the Minnesota River Valley near Granite Falls, Minnesota. K-Ar ages on hornblende from the dikes show that the tholeiitic diabase dikes were intruded more than 2,000 m.y. ago and that the hornblende andesite dikes were intruded approximately 1,800 m.y. ago.—Authors' abstract

06447 **Harbaugh, John W.** Computer simulation in petroleum accumulation in marine sediments [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 625–632, illus., 1967.

Computer simulation methods may be used to study the migration of petroleum in sedimentary rocks. Trend-surface analysis provides an effective method of ascertaining where oil entrapment conditions occur under an assumed set of conditions. The sedimentary basin simulation model (Harbaugh), combined by computer techniques with the trend-surface method of mapping hydrodynamic traps, may be used to simulate the migration and entrapment of oil under hydrodynamic conditions in a sedimentary basin that is undergoing development.—KAS

Harding, Samuel T. *See* Jordan, James N. 00201

00197 **Harlan, Richard C.** Slope stability during earthquakes—Discussion [of paper 5319 by H. Bolton Seed, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 5827, Jour. Soil Mechanics and Found. Div., no. SM2, p. 598–600, 1968.

The writer comments that Seed (ibid., v. 93, no. SM4, p. 299–323, 1967) has given an excellent review of the state of stability analysis in 1966. However, stability analysis alone cannot provide the necessary guide to modification in an earth dam during earthquakes. The practice of pseudostatic sliding circle analysis is placed in perspective rather than approved. Greater confidence can be placed in random failure surface stability analysis, considering dynamic forces, variations in soil shear strength, and pore pressures.—ESL

06216 **Harris, Henry C.** Effect of micronutrient deficiencies on mineral composition of certain plants and on animal and human nutrition, *in* Relation of geology and trace elements to nutrition—A symposium, New York, 1963: Geol. Soc. America Spec. Paper 90, p. 15–29, illus., tables, 1967.

Micronutrient content of the soil which greatly affects plant yields also affects food material quality. Acid soils were used in the experiments in Florida. Manganese had no effect. Cobalt and vanadium on legumes could increase crop yield, but only by a very small amount. Cattle develop salt-sick disease in Fe- and Cu-deficient soil, and this also affects anemia in children. Salt-sickness in cattle also comes from a Co deficiency. Florida soils that have been deficient in micronutrients are now difficult to locate because corrections have generally been made.—*from* Author's abstract

06032 **Harris, John M.** *Toxotherium* (Mammalia: Rhinocerotoidea) from western Jeff Davis County, Texas: Texas Memorial Mus. Pearce-Sellards Ser., no. 9, 7 p., illus., 1967.

A partial right ramus of *Toxotherium* contains the only known anterior cheek tooth of this genus. The geographic range of this genus is greatly extended by the occurrence of this specimen in Trans-Pecos Texas.—Author's abstract

06204 **Harriss, Robert C.** Clay minerals and oceanic evolution, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 207–214, illus., tables, 1967.

A review of mineralogical and geochemical studies on Recent marine sediments indicates the clay fraction is not in isotopic or chemical equilibrium with the oceanic reservoir and will not reflect the chemical environment of deposition. Sedimentary geochemistry of the alkali metals suggests that their fractionation, which may be a major feature of chemical evolution of ocean water, occurs in the terrestrial weathering environment during formation of clay minerals and in the subsurface environment during their diagenesis. It is proposed that during initial stages of oceanic development the Na/K ratio of ocean water was adjusted to a value of 40 to 50 by extensive diagenesis of existing natural water. With increase in oceanic volume and a major change in hydrologic cycling of natural waters, chemical

evolution of alkali metals in ocean water is now primarily controlled by mixing with continental drainage water.—*from* Author's abstract

06198 **Harward, M. E.; Carstea, D. D.** Properties of vermiculites and smectites—Expansion and collapse [abs.], *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 179, 1967.

Haskin, Larry A. *See* Norman, Jack C. 00293

Hathaway, John C. *See* Trüper, Hans G. 06003

06053 **Hattersley-Smith, G.; Long, Austin.** Postglacial uplift at Tanquary Fiord, northern Ellesmere Island, Northwest Territories: Arctic, v. 20, no. 4, p. 255–260, illus., table, 1967.

From the radiocarbon ages of samples of marine shells and peat, a postglacial uplift curve has been constructed for the upper part of Tanquary Fiord in northern Ellesmere Island. The dates show that the head of the fiord was clear of glacial ice by at least 6,500 years ago. From 6,500 to 5,000 years ago, isostatic uplift was at the rate of about 3.5 m per 100 yr and subsequently at the rate of about 25 cm per 100 yr.—Authors' abstract

06279 **Hausen, D. M.; Akright, Robert; Kerr, P. F.** Colloidal gold mineralization in Palaeozoic sediments of the Lynn mining district, Nevada [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B225, 1967.

06377 **Hawkes, H. E.** Recent review articles in geology: Earth-Sci. Rev., v. 3, no. 3, p. 135–155, 1967.

The 266 articles listed are taken from the 1964–66 volumes of Geoscience Abstracts, and are arranged under the 15 subject classifications used in them. Included are 178 reviews, 35 monographs, 19 texts, and 35 symposia. Paleontologic subjects present very different problems and are omitted. The bibliography is offered in part as an aid to geologists, and as a sample of how much and what kind of review material is available.—ESL

Hayatsu, Ryoichi. *See* Studier, Martin H. 00291

00294 **Hayatsu, Ryoichi; Studier, Martin H.; Oda, Atsuko; Fuse, Kiyono; Anders, Edward.** Origin of organic matter in early solar system—[Pt.] 2, Nitrogen compounds: Geochim. et Cosmochim. Acta, v. 32, no. 2, p. 175–190, illus., tables, 1968.

Previous identifications of nitrogen compounds in the Orgueil meteorite were confirmed. Guanylurea was identified as an additional, major constituent (270 ppm). All of the nitrogen compounds seen in carbonaceous chondrites (adenine, guanine, melamine, ammeline and guanylurea) form spontaneously, in yields of 0.1–0.5 percent, when CO, H_2 and NH_3 are allowed to react in the presence of iron meteorite powder. Cytosine, cyanuric acid, biuret and urea also form, along with an assortment of hydrocarbons similar to those in meteorites. These results support the suggestion of Studier, Hayatsu and Anders [1968], that the organic compounds in meteorites formed in the solar nebula by spontaneous reactions of CO, H_2 and NH_3. A large part of the prebiotic organic matter on the Earth may have originated in a similar manner.—Authors' abstract

00295 **Hayes, J. M.; Biemann, K.** High resolution mass spectrometric investigations of the organic constituents of the Murray and Holbrook chondrites: Geochim. et Cosmochim. Acta, v. 32, no. 2, p. 239–267, illus., tables, 1968.

Two methods for rapid preliminary analysis of organic geochemical samples are described. Although developed primarily for extraterrestrial samples, the methods are applicable to geological samples also. Both are broad and general, providing detailed information on organic compound types, structures, distributions, and heteroatomic contents. In the first method, samples are heated directly on the ion

source of a high-resolution mass spectrometer, the volatilized materials being analyzed as evolved. In the second, samples are heated directly at the entrance of a gas chromatograph attached to the high-resolution mass spectrometer; qualitative analysis of the chromatographic effluent is easily possible and the chromatogram itself provides a quantitative record. The methods have been applied to the Murray C2 and Holbrook L6 chondrites, with results described here.—DBV

00274 **Heard, Hugh C.; Carter, Neville L.** Experimentally induced "natural" intragranular flow in quartz and quartzite: Am. Jour. Sci., v. 266, no. 1, p. 1–42, illus., tables, 1968.

Quartz crystals and quartzite deformed dry in a new apparatus at 6 to 10 kb confining pressure, 500° to 1020°C, and at strain rates of 10^{-5} to 10^{-7} per sec, show permanent strains of 1 percent to >10 percent by intragranular slip and/or minor recrystallization. An increase of 50° to 100°C decreases strength similarly to a tenfold decrease in strain rate in both materials. Quartz deformation lamellae have been produced on single crystals and in an orthoquartzite with random crystallographic orientation. All deformation mechanisms depend upon confining pressure, temperature, stress difference, and strain rate. These experimental results firmly establish three methods for determining principal stress directions in quartz-bearing tectonites.—*from* Authors' abstract

Hearst, J. R. *See* Carlson, R. C. 00184

06433 **Hedberg, H. D.** Geologic controls on petroleum genesis [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 3–11, table, 1967.

Examples are presented of observed relationships of petroleum character to such geologic features of the presumed source area as: lithology, province of deposition, salinity of waters, age, subsurface temperature, organic content, coals, evaporites, fossils, volcanism, rate of sedimentation, and degree of metamorphism. Examples are given of the relationship to oil gravities of features such as: age, depth of burial, basinal position, tectonism, lithology, and salinity of depositional waters. High wax content of oils is frequently related to continental origin. Sulfur content may reflect source material and depositional environment.—*from* Author's abstract

Hedlund, D. C. *See* Olson, J. C. 00374

06061 **Hedlund, Richard W.** Taxonomic reevaluation of spore taxa from the Cenomanian of Oklahoma: Pollen et Spores, v. 9, no. 3, p. 579–582, illus., 1967.

The palynologic assemblage of 74 species (21 new) from the Red Branch Member of the Lower Cretaceous Woodbine Formation, Bryan County, Okla., was described by Hedlund (1966). Study of additional material and newly published works, and further study of previously published works, have led to necessary, revised taxonomic placement of two species of trilete spores. Those appearing in Hedlund (1966) as *Cicatricosisporites dorogensis* Potonié and Gelletich, 1933, are here reassigned to *Cicatricosisporites hallei* Delcourt and Sprumont, 1955; those appearing as *Camarozonosporites rudis* (Lischik, 1955) Klaus, 1960, are reassigned to *Camarozonosporites insignis* Norris, 1967.—VMJ

06221 **Heller, L.** (editor). Proceedings of the International Clay Conference, Jerusalem, Israel, 1966, V. 2: Jerusalem, Israel Program Sci. Translations, 309 p., illus., tables, 1967.

Volume 2 of the proceedings contains recent results reported by some authors, the discussions, additional papers read at the Conference (two of which are cited separately), and the introductions and summaries by the chairmen of the various sections. English translations of contributions appearing in Russian in volumes 1 and 2 are given at the end of this book.—ESL

06192 **Hendricks, D. M.; Whittig, L. D.; Jackson, M. L.** Clay mineralogy of andesite saprolite, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa.,

1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 395–407, illus., tables, 1967.

Clay mineral associations in saprolite of two andesites from the Cascade Range of northeastern California were determined. Sesquioxidic allophane with a high CEC delta value dominates the clay fraction of least weathered saprolites (47 and and 37 percent in hypersthene andesite and olivine andesite saprolites, respectively). With further weathering, the content of amorphous clay remains high but the CEC delta value drops markedly and amorphous material has properties of halloysitic allophane. Halloysite, present in all saprolites, is highest in concentration in the more strongly weathered members of each of the series. Formation of sesquioxidic allophane during early stages of weathering and transformation to halloysitic allophane and halloysite during later stages are supported by X ray diffraction, electron microscopic, DTA, elemental analysis, and CEC delta value data.—Authors' abstract

06095 **Henningsen, D.** Umkehrung von Festland und Meeresraum im südlichen Zentralamerika: Deutsch. Geol. Gesell. Zeitschr. 1964, v. 116, no. 3, p. 584–588, illus., 1967.

In Nicaragua, Costa Rica, and Panama a change from continent to ocean occurred in a relatively short time. The basal stratigraphic complex consists of calcareous, siliceous, and clastic (tuffaceous sediments) rocks intercalated with basaltic lavas. In Costa Rica the complex occurs only on the Pacific side but is probably in the subsurface inland. In Panama, it consists mainly of volcanic rock. On the basis of Foraminifera, the age has been determined as Upper Cretaceous. Middle Eocene marine sediments and volcanics were deposited in this same area. At the Mio–Pliocene boundary tectonic movements changed the area from a marine to continental environment. It is suggested that Pacific volcanic islands, west of the present coast, were the source of Cretaceous and Tertiary tuffaceous sediments.—CRG

06420 **Henningsen, Dierk.** Crushing of sedimentary rock samples and its effect on shape and number of heavy minerals: Sedimentology, v. 8, no. 3, p. 253–255, 1967.

A few examples are given to demonstrate that crushing of hard sedimentary rocks does not break up the heavy minerals present in the rock. Moreover, the ratios of the various minerals for the most part are not changed.—*from* Author's summary

00300 **Herbertson, John G.** River bed degradation below dams—Discussion [of paper 5335 by S. Komura and D. B. Simons, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 5825, Jour. Hydraulics Div., no. HY2, p. 589–590, 1968.

The writer makes some comments on use of the Kalinske–Brown equation in paper 5335 [ibid., v. 93, no. HY4, p. 1–14, 1967].—ESL

Hermon, Erica. *See* Lerman, Abraham, 00213

Heron, S. Duncan, Jr. *See* Swift, Donald J. P, 06324

06103 **Herr, R. L.** Upper Cretaceous Alberta Group in the subsurface of Waterton gas field: Canada Geol. Survey Paper 65–37, 22 p., illus., geol. map, 1967.

The Alberta Group is divisible into several lithologic units, some probably equivalent to units established for the eastern Cordillera. Weathering effects which distinguish the surface units are not evident in bore hole samples. Because of lack of paleontological control, only suggested correlations are presented. The thinning of the Blackstone Formation from north to south in the foothills is extended into the subsurface of the Harland Lakes thrust fault, to a minimum of 110 feet in the Shell 10 Waterton well. The Ram and Sturrock Members of the Cardium Formation are readily recognized; its other members are not positively correlated. Members of the Wapiabi Formation designated by Stott are not readily recognizable in subsurface.—GDC

06081 **Herrin, Eugene.** The crust and continents, *in* The Earth in space (Hugh Odishaw, editor): New York and London, Basic Books, p. 68–76, 1967.

This is a semipopular account of the nature of the Earth's crust and continents. A bird's eye, collapsed time view is described, followed by an account of Hutton's uniformitarian theory. The relationship of erosion and sedimentation to isostatic adjustment and continental drift are discussed also, and the origin of the energy in the mantle is described.—HRC

06208 **Hershey, Robert E.** Mineral resources summary of the Reagan quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 9 p., tables, 1967.

The only mineral resource mined in the Reagan quadrangle is sand, mining of which is restricted to the Late Cretaceous McNairy Sand; most has been used as foundry sand, but it is also a source of glass sand. A potential resource is heavy mineral sand. The accompanying map by E. E. Russell (Tennessee Div. Geology Geol. Map GM 11-SE) is cited separately.—MCM

06210 **Hershey, Robert E.; Wilson, Charles W., Jr.** Mineral resources summary of the Pulaski quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 8 p., 1967.

Mineral resources mined in the Pulaski quadrangle are phosphate and limestone; potential resources are chert, gravel, and sandstone. All phosphate mines and deposits are within the outcrop area of the Bigby Cannon Limestone; minor deposits may have been derived from gradational beds between the Bigby Cannon and the underlying Hermitage Formation. Carters and Ridley Limestones contain the most desirable stone for general purposes. This text accompanies Tennessee Div. Geology Geol. Map GM 59 NE by C. W. Wilson, Jr. and J. P. Kirby (cited separately).—MCM

06245 **Hess, H. H.; Poldervaart, Arie.** (editors). Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1: New York and London, Interscience Publishers, 482 p., illus., tables, 1967.

This is a symposium containing 12 papers dealing with many aspects of basalts. Each paper is cited individually by author.—HRC

00297 **Heymann, D.; Mazor, E.** Noble gases in unequilibrated ordinary chondrites: Geochim. et Cosmochim. Acta, v. 32, no. 1, p. 1–19, illus., tables, 1968.

The rare gases were determined mass spectrometrically in 11 unequilibrated ordinary chondrites. The amounts of primordial Ar, Kr, and Xe are systematically greater than in ordinary chondrites. Primordial Ne was detected in only two of the meteorites. The amounts of Ar, Kr, and Xe are approximately inversely proportional to the degree of equilibration of Fe in olivine, and are directly proportional to C contents. Carbonaceous chondrites, unequilibrated ordinary chondrites, and ordinary chondrites proper form a sequence of decreasing contents of primordial rare gases of the "planetary" type [Signer and Suess, 1963]. This is consistent with a recent theory by Larimer and Anders (1967) on formation of these meteorites. It is inferred, however, that Ne does not belong to the "planetary" component.—*from* Authors' abstract

06045 **Heywood, W. W.** Geological notes, northeastern District of Keewatin and southern Melville Peninsula, District of Franklin, Northwest Territories (parts of 46,47,56,57): Canada Geol. Survey Paper 66-40, 20 p., illus., tables, geol. maps, 1967.

A reconnaissance survey of 55,000 miles is reported. Precambrian rocks of Aphebian (early Proterozoic) age have been moderately to intensely folded, metamorphosed, granitized, and here and there intruded by granitic and pegmatitic rocks. Flat-lying Ordovician and Silurian sandstone and dolomite outcrop on Simpson and Melville Peninsulas and on Southampton Island. Twelve K-Ar age determinations were made on the Precambrian rocks; the results range from 1580 to 1690 m.y. Tentative correlations are made between some of the units of the area and

lithologically similar units in adjacent regions. The results of analyses on an iron formation unit are given.—*from* Author's abstract

06249 **Higbee, Howard William.** Land resource map of Pennsylvania: University Park, Pa., Pennsylvania State Univ. Coll. Agriculture, Agr. Expt. Sta., scale 1:380,160, 1967.

A chart of "soil unit" evaluations contains: map color and soil unit symbols, name of group unit, depth to bedrock in feet, drainage environment, approximate soil reaction in pH values, color, mode of material accumulation, geologic source of material, texture, subsoil porosity or permeability, approximate depth of plant rooting zone in inches, moisture storage capacity, percent slope environment of a unit, crop production limitations or restrictions, approximate percent of a unit in forest and crop land, major crops grown on unit areas, and physiographic location of soil unit in Pennsylvania.—MCM

06063 **Hills, L. V.** *Ariadnaesporites, Capulisporites or Caudaspora*—A discussion [with French abs.]: Pollen et Spores, v. 9, no. 3, p. 553–562, illus., 1967.

The present discussion is based on a review of literature dealing with all genera and species of plant micro- and megaspores (of marsileaceous ferns) having a trifolium (three leaflike extensions of the laesurae) and distal hairlike processes. All are shown to be morphologically similar and congeneric. It is concluded that *Capulisporites* Potonie 1956 and *Caudaspora* Elsik 1966 are junior synonyms of *Ariadnaesporites* (Potonie) emend. Tschudy 1966. *Arcellites mirabilis* Kimyae 1966 and *A. caudatus* Kimyae 1966 are transferred to *Ariadnaesporites*. The relatively restricted age range of the eight species (Upper Cretaceous, chiefly Campanian) and wide geographic distribution in the Northern Hemisphere suggest usefulness as an index fossil.—VMJ

Hills, L. V. *See* Trettin, H. P. 06244

Himmelberg, G. R. *See* Hanson, G. N. 06018

06042 **Himmelberg, G. R.; Phinney, William C.** Granulite facies metamorphism, Granite Falls-Montevideo area, Minnesota: Jour. Petrology, v. 8, no. 3, p. 325–348, illus., tables, 1967.

Analysis of granulite facies mineral assemblages, collected in this area from Precambrian hornblende-pyroxene, garnet-biotite, and granitic gneisses, indicate that these rocks attained a close approach to chemical equilibrium during metamorphism, although some phase diagrams suggest that H_2O and O were not always perfectly mobile components. This is also indicated by interlayering of hornblende and pyroxene assemblages, and by different iron oxide phases in the same mineral assemblage. Some retrograde reactions may be a result of cooling following granulite facies metamorphism; others may have recrystallized during the thermal event that reset the K/Ar and Rb/Sr biotite ages in the metamorphic rocks.—GDC

00333 **Hinrichs, E. N.; Krummel, W. J., Jr.; Moore, H. J., 3d; Connor, J. J.** Geologic map of the northeast quarter of the Hatch Point quadrangle, San Juan County, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I–526, scale 1:24,000, 1968.

00203 **Hirshberg, Joan; Currie, Robert G.; Breiner, Sheldon.** Long period geomagnetic fluctuations after the 1964 Alaskan earthquake: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 426–428, illus., 1967 [1968].

The Alaskan earthquake of 28 March, 1964 excited the Earth's eigenvibrations. However, the only power spectrum of the magnetic field reported for the period after the Alaska earthquake failed to show any significant peaks. In this note, we present power spectra of the post-quake geomagnetic field that do show lines having frequencies of several of the gravest torsional eigenmodes of the Earth.—*from* Authors' abstract

Hoadley, Alfred W. *See* Lee, G. Fred, 06413

00332 **Hoare, J. M.; Condon, W. H.** Geologic map of the Hooper Bay quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-523, scale 1:250,000, separate text, 1968.

Bedrock exposed in the Hooper Bay quadrangle (Yukon Norton Sound region) consists of: sandstone and siltstone, assigned a Cretaceous age, and apparently roof pendants in the granodiorite pluton which makes up most of the Askinuk Mountains; granodiorite, cut by at least two well defined sets of fractures and probably a part of a large intrusive body underlying an extensive area; and basalt, consisting of a fine grained matrix with scattered phenocrysts of pyroxene and olivine and assigned to the Quaternary. The granodiorite pluton contains several northwest-trending lineaments interpreted as fault traces. Surficial deposits are mostly fluvial but include small areas of glacial deposits in the Askinuk Mountains.—MCM

Hobbs, P. V. *See* Ketcham, W. M. 06269

06395 **Hobson, George D.; Overton, A.** A seismic section of the Sverdrup basin, Canadian Arctic Islands, *in* Seismic refraction prospecting (A. W. Musgrave, editor): Tulsa, Okla., Soc. Explor. Geophysicists, p. 550-562, illus., 1967.

Seven seismic refraction profiles, completed in 1961, were shot along a line extending from a location 30 miles north of Ellef Ringnes Island, along the island's west coast to a point 30 miles south of the island into Belcher Channel. An S-55 helicopter was used with supply support and major moves by Otter fixed-wing aircraft. Dynamite charges were detonated in depths of water to 1,285 feet without the use of 'boosters.' A Decca Survey Chain provided regional navigation but this system is not sufficiently accurate for long range seismic refraction surveying. These seven profiles (a cross section across the Sverdrup Basin) correlated by seismic velocities, indicate a thickness of approximately 40,000 feet of sediment in the center of the basin to a formation with a horizontal velocity of 20,000 feet/sec. 'Basement' or base of unmetamorphosed sediments may be 64,000 feet deep at this location.—*from* Authors' abstract

06446 **Hobson, George D.** A reconnaissance seismic refraction survey in Hudson Bay, Canada [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 813-826, illus., 1967.

Seismic surveys were conducted in Hudson Bay during August and September 1965 as part of an extensive and comprehensive survey encompassing the fields of geophysics, geology and oceanography. Seismic velocities in excess of 11,300 ft per sec were observed. A high velocity of 22,000 ft per sec was recorded consistently on the east side of the Bay indicating that there may be a considerable thickness of Proterozoic sediments underlying a considerable portion of the Bay. Lower and intermediate seismic velocities indicate the probable presence of Mesozoic sediments overlying the Paleozoic section. The thickness of sediments overlying the Proterozoic is calculated to be about 6,000 feet. There appears to be considerable structure within the sedimentary section. It is anticipated that a deep hole will be drilled in the Bay.—*from* Author's abstract

06193 **Hoekstra, P.; Keune, R.** Pressure effects on conductance of frozen montmorillonite suspensions, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 215-225, illus., table, 1967.

The influence of pressure on the conductance of frozen montmorillonite suspensions was measured in the temperature range from 0°C to -12°C on Na- and Ca-saturated samples. Pressures invariably increase the conductance of frozen suspensions. The change in conductance with pressure is postulated to be due to pressure melting of the ice in the frozen suspension. From swelling pressure data the increase in unfrozen water with pressure at constant temperature is calculated

and shown to be consistent with the effect of pressure on conductance.—Authors' abstract

06075 **Hofmann, R. B.** Errata ["Parkfield earthquakes June 28–29, 1966," by P. W. Morrison, R. B. Hofmann, J. E. Wolfe (1966)]: Earthquake Notes, v. 38, no. 1, p. 29, 1967.

W. K. Cloud of the U.S. Coast and Geodetic Survey has reported orientations of mutually owned instruments which differ from those given earlier (ibid., v. 37, no. 3, p. 5–18, 1966). While they do not alter the conclusions, three errata are listed to keep the data consistent.—ESL

00318 **Hohenberg, C. M.** I-Xe dating of the Shallowater achondrite: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 357–362, illus., table, 1967 [1968].

Xenon from a pile-irradiated sample of the Shallowater, Texas, enstatite achondrite was analyzed in a step-wise heating experiment. Below 1200°C very little radiogenic Xe-129 was observed. Above this temperature radiogenic Xe-129 was released in excellent correlation with Xe-128, from neutron capture on iodine, satisfying the requirements for I-Xe dating. The ratio of I-129 to I-127 when Shallowater began retaining xenon is the same within experimental error as the ratio in 10 chondrites previously measured, indicating that Shallowater and these chondrites began to retain xenon simultaneously to within one or two million years. Calculated values of the formation interval for these bodies lie between 60 and 220 million years depending upon the model for nucleosynthesis assumed.—Author's abstract

06280 **Holland, H. D.** Chemistry of the replacement of limestone by sphalerite at temperatures up to 250°C [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B225, 1967.

Holland, H. D. *See* Gammon, J. B. 06396

Holz, Robert K. *See* Bryant, Vaughn M., Jr. 00260

00311 **Hoque, Momin ul.** Sedimentologic and paleocurrent study of Mauch Chunk sandstones (Mississippian), south central and western Pennsylvania: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 246–263, illus., tables, 1968.

The Mauch Chunk sandstones comprise two groups: subgraywacke, forming the dominant group, and protoquartzite. The subgraywacke was deposited on a fluvial and prograding deltaic plain; the dominant current direction was westward, indicating an eastern source in sedimentary clastics and a metamorphic complex. The protoquartzite was deposited in a nearshore marine environment during early Mauch Chunk sedimentation; the source rock was mature and multicycled sediments north and northwest of the study area. The Mauch Chunk, in cross section, is wedge-shaped and thins westward; westward thinning of the terrigenous clastics is accompanied by an increase in the thickness of marine carbonates. The sedimentary model presented for the formation is a molasse basin, an elongate miogeosynclinal basin in which terrigenous deposits thicken toward the source and thin seaward.—EAM

06260 **Houghton, A. Sherrill; Howe, W. Warren.** Organic metal complexes in the Uinta Basin [with Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 703–705, tables, 1967.

Determinations of organic iron and nickel have been used as clues to the relationship between the extensive Green River oil shale deposits and much smaller occurrences of gilsonite, wurtzilite, tar sands and petroleum in the Uinta Basin. Insoluble kerogen, comprising about 80 percent wt of the total organic matter, was separated from the oil shale by pyrolysis after extraction of the 20 percent wt soluble oil shale bitumen. The ratio of iron to nickel in the pyrolyzed kerogen was 8.9 to 1. All other iron-nickel ratios were much smaller. The Red Wash oil, for example, contained 23 ppm of iron and 14 ppm of nickel^2. It was concluded that kerogen was the source of all the other materials.—Authors' abstract

Howe, W. Warren. *See* Houghton, A. Sherrill. 06260

06074 **Howell, B. F., Jr.** Density in the earth knowing only the seismic velocities: Earthquake Notes, v. 38, no. 1, p. 15–21, illus., table, 1967.

Densities in the Earth are recalculated using Bullen's (1940) method, taking into account the existence of the mantle low-velocity zone. This raises densities down to 5,850 km radius and in the core, and lowers them in the lower mantle. Clark and Ringwood's (1964) eclogite model is more consistent with the seismically predicted values than is their pyrolite model.—Author's abstract

06123 **Hower, John.** Order of mixed layering in illite/montmorillonites, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 63–74, illus., tables, 1967.

A number of poorly understood compositional structural relationships appears to be explained by ordered interlayering between high and low charge 2:1 units. Tentative conclusions are: illites are virtually nonexpandable at lattice charges significantly less than that of ideal mica, illites and mixed layer illite/montmorillonites with the same mean lattice charge show a range of expandability because of varying degrees of ordering, and the highly variable CEC of samples with the same expandability also results from a varying degree of ordering. Low expandability should be promoted by formation at high pressures. Glauconites, known to form largely at the time of sedimentation, appear to be dominantly randomly interstratified; illites and illite/montmorillonites, which may form on deep burial of argillaceous sediments, are dominantly ordered.—*from* Author's abstract

06419 **Howie, R. A.** Current trends in mineralogy: Earth-Sci. Rev., v. 3, no. 1, p. 31–46, illus., 1967.

The instrumentation of analytical techniques includes development of atomic absorption spectroscopy, X-ray fluorescence analysis (including portable radioisotope apparatus), electron probe microanalysis—both for determining minute mineral phases or zonal variations and for major element analysis of rock-forming minerals—and membrane colorimetry. Also developed are measurements of the Mössbauer effect, infrared spectrophotometry and the study of pleochroism, and old techniques of hardness and specific gravity on a microscale. Recent work on vesuvianite, cordierite, the garnet group, and sulfide geothermometry is outlined, as are notes on the Al_2SiO_5 polymorphs and the amphiboles.—*from* Author's summary

06148 **Hoyt, John H.** Occurrence of high-angle stratification in littoral and shallow-neritic environments, central Georgia coast, U.S.A.: Sedimentology, v. 8, no. 3, p. 229–238, illus., 1967.

High-angle stratification (greater than 20°) is produced in several areas of shallow-water sedimentation along the barrier islands of Georgia. The maximum angle, 30°, is the angle of repose for the saturated, fine-grained, angular sand. It occurs in (1) depositional margins of tidal channel inlets, (2) in the steep faces of asymmetrical megaripples developed by tidal currents, (3) in the steep faces of sand waves formed in channel inlets, (4) on the landward side of low bars developed on beaches, and (5) on the oceanward side of large sand waves at the mouths of offshore tidal channels.—*from* Author's summary

06236 **Hriskevich, M. E.** Middle Devonian reefs of the Rainbow region of northwestern Canada, exploration and exploitation [with French abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 733–763, illus., 1967.

Three separate pulses of reef growth which occurred in northwestern Canada during Middle Devonian, are in order of decreasing age: Keg River (Rainbow Member), Sulphur Point, and Slave Point reefs. Study of stratigraphy and structure reveal that distribution of the Keg River reefs determined the extent and configuration

of the two younger reefs in British Columbia; no such relation is apparent in the eastern part. Seismic exploration is reviewed briefly; results emphasize the necessity of adapting techniques to the geology of the particular part of the basin under exploration. Exploratory and development drilling has confirmed recoverable reserves of more than a billion barrels of oil in the reefs in Alberta and substantial reserves in British Columbia. Mathematical model studies of the discovery reservoir confirm that primary recovery will be 57 percent of oil in place.—VSN

06403 **Hubbert, M. King.** Application of hydrodynamics to oil exploration [with French and Spanish abs.], *in* Latest development within the oil industry—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 1B: London, Elsevier Publishing Co., p. 59–75, illus., 1967.

The theory of hydrodynamic entrapment of hydrocarbons is reviewed. As a conspicuous example of hydrodynamically tilted oil and gas deposits, the area comprising the combined Hugoton–Amarillo gas field (Kansas and Oklahoma) and Panhandle oil field (Texas) is described in some detail. Other examples are described briefly. Outside the United States hydrodynamic effects are suspected in the Poza Rica field of Mexico, the east side of Lake Maracaibo, Trinidad, Kurkuk in Iraq, Digboi in India, and the Lanya and Chauk fields of Burma. As yet few discoveries of new fields can be credited to hydrodynamic analysis. However such analysis must become routine exploration practice if many large fields are not to remain undiscovered.—KAR

00209 **Huddle, John W.** Redescription of Upper Devonian conodont genera and species proposed by Ulrich and Bassler in 1926: U.S. Geol. Survey Prof. Paper 578, 55 p., illus., 1968.

A classic paper on conodonts by Ulrich and Bassler, published in 1926, led to the recognition of the stratigraphic usefulness of conodonts. Many of the species they described need revision because later studies have shown the need for information not given in the original descriptions and because the types were not completely exposed when photographed. The types have been prepared, rephotographed, and redescribed. The collections came from the Rhinestreet Shale Member of the West Falls Formation in New York, the Gassaway Member of the Chattanooga Shale in Alabama, and the Mississippian(?) "Hardin sandstone" in Tennessee.—JWH

Huffman, Claude, Jr. *See* Sainsbury, C. L. 06362

06145 **Hülseman, Jobst.** The continental margin off the Atlantic coast of the United States—Carbonate in sediments, Nova Scotia to Hudson Canyon: Sedimentology, v. 8, no. 2, p. 121–145, illus., 1967.

Samples of surface sediment on a ten mile grid show that over 90 percent or more of its area the shelf sediment contains less than five percent carbonate. The values are due to low production by aquatic organisms because of low water temperatures. A few localities have higher $CaCO_3$ due to a prolific sessile or near sessile fauna. The percentage increases regularly seaward from the shelf to about 30 percent on the upper continental rise, reflecting an increase in planktonic Foraminifera due to a decrease in the rate of land-derived detritus. Limestone outcrops are very rare in the area.—*from* Author's abstract

Hutchinson, C. A., Jr. *See* Polasek, Theo L. 06436

06399 **Illing, L. V.; Wood, G. V.; Fuller, J. G. C. M.** Reservoir rocks and stratigraphic traps in non reef carbonates [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 487–499, illus., 1967.

Bedded limestones in which primary inter grain pore space remains uncemented characterize undeformed areas of continuous miogeosynclinal carbonate sedimentation. In folded areas and in epicontinental regions where the sedimentary sequence is more frequently interrupted, lime sediments tend to be tightly cemented by secondary calcite. Under these conditions diagenetic porosity is more important, dolomite being the chief carbonate reservoir rock. Microdolomites are poorly

permeable but often highly porous and, when interbedded with anhydrite, form cap rocks. Macrodolomites have coarser porosity and are excellent reservoir rocks. Production is possible from coarser varieties of chalk, particularly where jointed or fractured. Stratigraphic traps in Mississippian carbonates of Saskatchewan and North Dakota are discussed.—*from* Authors' abstract

06445 **Ion, D. C.** The significance of world petroleum reserves [with Spanish abs.], *in* Latest development within the oil industry—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 1B: London, Elsevier Publishing Co., p. 25–36, tables, 1967.

The latest estimates (Hendricks, 1965) of the ultimate resources or the amount of petroleum originally in place in the world is 6,200 billion bbl. The published estimate of the proved reserves or the remaining amount of petroleum producible from known reservoirs under existing economic and operating conditions was 382 billion bbl in 1966. The author discusses the following: quality, location, and market demand of oil reserves; natural gas reserves; viscous and solid petroleum; and uses of reserve statistics.—KAS

06050 **Jackson, D. E.** *Psigraptus*, a new graptolite genus from the Tremadocian of Yukon, Canada: Geol. Mag., v. 104, no. 4, p. 317–321, illus., 1967.

The new genus, *Psigraptus*, containing *P. arcticus* n.sp. and genotype and *P. lenzi* is proposed for two-branched and three-branched reclined graptolites with isolate autothecae. The genus is known only from the *Bryograptus–Clonograptus* Zone (Tremadocian), Yukon Territory.—Author's abstract

Jackson, M. L. *See* Hendricks, D. M. 06192

Jackson, S. A. *See* Folinsbee, R. E. 06286

05994 **Jagodzinski, Heinz; Haefner, Karl.** On order disorder in ionic non stoichiometric crystals [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 188–200, illus., 1967.

A method for the construction of a mistake model useful for the calculation of diffuse intensities in ionic non-stoichiometric compounds is described. The method is illustrated on magnesium-aluminum spinel containing a surplus of aluminum oxide, and the resulting model is used to explain qualitatively the dissolution behavior of this spinel.—Authors' abstract

06058 **James, Noel P.; Stanley, Daniel J.** Sediment transport on Sable Island, Nova Scotia: Smithsonian Misc. Colln., v. 152, no. 7 (Pub. 4723), 33 p., illus., 1967.

Sable Island is a bar emerging from the outer continental shelf. A 6,800 year old paleosol covers aeolian sand from a lower sea stand. Lateral distribution of the sands suggests that the north and south sides of the island are subject to different physical conditions and that the net sediment movement is toward the northeast. Beach and dune sand can be separated texturally; different sedimentological techniques are used to distinguish the sands. Two parallel dune chains form the backbone of the island and occupy the position between strong winter winds from the northwest and gentle summer winds from the southwest. The sea wind combination causes cyclical movement of the sand out to sea and back to land. Sable Island is not being destroyed as earlier predicted.—*from* Authors' abstract

06002 **Jamkhindikar, Suresh.** Sedimentary characteristics of Pleistocene deposits, Neosho River valley, southeastern Kansas: Kansas Geol. Survey Bull. 187, pt. 5, 13 p., illus., tables, 1967.

Clay mineralogy, sedimentary parameters, and heavy mineral content of Pleistocene alluvial terrace and flood plain deposits were investigated. The clay mineral assemblage consists of montmorillonite, a 14A mixed layer mineral, illite, and kaolinite. Montmorillonite is dominant in alluvial terraces. Flood plain deposits contain montmorillonite, illite, and kaolinite in decreasing order of relative abundance. Relative abundances in each deposit are evaluated in terms of contribution of the source area, weathering, time, topography, and drainage. Grain

size analyses of both deposits did not reveal a significant difference in parameters. Terrace deposits did show greater variation in sorting than flood plain, but not enough to differentiate them. The heavy mineral assemblage consists of zircon, tourmaline, staurolite, garnet, topaz, and magnetite, with minor amounts of epidote and kyanite in the flood plains.—*from* Author's abstract

Jarrett, P. M. *See* Crawford, C. B. 06059

06379 **Jarvik, Erik.** On the structure of the lower jaw in dipnoans—With a description of an early Devonian dipnoan from Canada, *Melanognathus canadensis* gen. et sp. nov.: Linnean Soc. London Jour.,Zoology, v. 47, no. 311, p. 155–183, illus., 1967.

Comparison of the lower jaw in *Melanognathus* n.gen. and other Devonian dipnoans with that in Recent *Neoceratodus* shows that there has been essentially no change in the structure since the Devonian and that there are fundamental differences from those in rhipidistid crossopterygians, tetrapods, and actinopterygians. *M. canadensis* n. gen. n. sp. is erected for an incomplete jaw from vertebrate-bearing beds tentatively dated as lower Devonian in the Ross River region, District of Mackenzie.—GSA Bib. Staff

00363 **Jenny, W. P.** How dual-level aeromagnetic surveys aid interpretation: World Oil, v. 166, no. 4, p. 79–83, illus., 1968.

Dual level surveying with high sensitivity aerial magnetometers permits determination of a greater number of microanomalies, new interpretational concepts, and reassessment of previously known anomalies. Properly interpreted, microanomalies are significant indications of local structure and likely hydrocarbon deposits. Similarity of magnetic and gravity microprofiles over producing structures to those derived independently by other methods suggests that the various methods measure and record essentially the same shallow stratigraphic and(or) structural features.—Author's abstract

00367 **Jillson, Willard Rouse.** The extinct Vertebrata of the Pleistocene in Kentucky: Frankfort, Ky., Roberts Printing Co., 122 p., illus., 1968.

A cursory description of the Pleistocene sediments in Kentucky is followed by a narrative of the discovery of Big Bone Lick in 1739. An account is given of the general historical aspects of the discovery of other bones and the enlargement of the Big Bone Lick digging. Finally, known Pleistocene vertebrates are summarized by county, and a 165 title annotated bibliography is given. No descriptions of the animals are included.—HRC

00312 **Johnson, A. I.; Moston, R. P.; Morris, D. A.** Physical and hydrologic properties of water bearing deposits in subsiding areas in central California: U.S. Geol. Survey Prof. Paper 497-A, p. A1–A71, illus., tables, 1968.

Land subsidence in the San Joaquin and Santa Clara Valleys, Calif., is causing serious problems with large engineering projects. Subsidence in the San Joaquin Valley, the Los Banos–Kettleman City and Tulare–Wasco areas, is critical because of the Friant Canal of the Central Valley project and the to-be-constructed canal, traversing 70 miles of subsiding land, to serve the San Luis project and the California Aqueduct. Eight holes, 1,000 to 2,000 feet deep, were cored to obtain samples for analysis of physical, hydrologic, and engineering properties. Sediments from the Los Banos–Kettleman City area and the San Joaquin Valley are fine textured and clayey silt or silty clay types; those of the Tulare–Wasco area are medium textured and silty clay or sand silt clay types. Laboratory data are presented in tabular and graphic form, analysis methods described, and interrelation of physical and hydrologic properties shown.—BSH

06125 **Johnson, A. I.; Sniegocki, R. T.** Comparison of laboratory and field analyses of aquifer and well characteristics at an artificial recharge well site [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 182–192, illus., 1967.

Research on artificial recharge of alluvial deposits by wells was carried out in the Grand Prairie region, Ark. Test drilling and construction of observation wells provided information on Quaternary deposits. From laboratory analyses of samples collected from pilot test holes for recharge wells, a transmissibility of 60,000 gpd per ft and a storage coefficient of 0.34 were predicted. Pumping and recharge tests in the field confirmed these values. Slow drainage from fine-textured portions of the aquifer resulted in a change in storage coefficient with time. However, field data showed the storage coefficient probably would have reached the value predicted if tests had been run for a longer time. It is concluded that if laboratory analyses of water-bearing materials are used in conjunction with field tests, a more thorough understanding of the hydrologic system under injection conditions will result.—*from* Authors' abstract

06448 **Johnson, James F.** Surface sources of seismic energy [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 709–716, illus., 1967.

This paper is a discussion of surface seismic energy sources for oil exploration. Some of the sources to be discussed are weight drop, Vibroseis, Dinoseis, and other surface impacting devices such as spring driven and air-driven piston systems. Methods of using these devices in the field also will be discussed. The application of compositing methods both on the ground and in the computing processes will be discussed. The application of digital methods of this type of seismic work will also be presented.—Author's abstract

00180 **Johnson, Ross B.** The Great Sand Dunes of southern Colorado: Mtn. Geologist, v. 5, no. 1, p. 23–29, illus., 1968.

The Great Sand Dunes National Monument is in the San Luis Valley of southern Colorado. Large areas of transverse, climbing dunes, barchans, longitudinal dunes, parabolic dunes of accumulation and of deflation occur in and adjacent to the Monument. They have all formed more or less contemporaneously, though different processes in different areas have created the various types. The San Juan and Sangre de Cristo Mountains are the original source of the sand; the immediate sources are the ancient natural levees and dry oxbow lakes of the Rio Grande.—*from* Author's abstract

06113 **Johnson, Thelma A.; Peters, Helen J.** Regional integration of surface and ground water resources [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 493–499, illus., 1967.

California's ground water development has been local, while that of surface water has been extended to large developments. The California Water Plan outlines far future plans for surface and ground-water resources, but does not provide for stages. Continuing staging studies are designed to produce and refine a time-related economic plan to meet water needs; full integration of ground and surface water resources is necessary. The planned integration must be staged within a proper framework of economic criteria. These and possible alternative physical possibilities are explored. Some project purposes and benefit measurement and economic demand techniques are identified. Successive approximation steps in applying economic criteria are outlined. Questions of conflict between economic benefits and costs at local and regional levels and administrative considerations are explored.—*from* Authors' abstract

06376 **Joiner, Thomas J.; Warman, James C.; Scarbrough, W. Leon; Moore, Donald B.** Geophysical prospecting for ground water in the Piedmont area, Alabama: Alabama Geol. Survey Circ. 42, 48 p., table, 1967.

It is difficult to locate in the Piedmont adequate ground water whose occurrence and movement is controlled by topography, recharge and discharge, rock type, fracture systems, and type and thickness of saprolite. This study covers 12 sq mi in the Heflin area, Cleburne County, Ala., where fractures within igneous and metamorphic bedrock are the most effective avenues; however, domestic supplies can be obtained from saprolite and alluvium. Thick saprolite contributes slow

recharge to bedrock fractures. Seismic methods were used with geologic, hydrologic, and topographic data to define 25 favorable drilling areas. Faults or fracture systems appear to correlate with depressions on bedrock surfaces associated with thick saprolite zones. Resistivity data confirm seismic depths to bedrock, and locate gravelly zones in buried stream channels, some thick enough to be potential aquifers.—GDC

06119 **Jonas, Edward C.; Oliver, Robert M.** Size and shape of montmorillonite crystallites, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 27–33, illus., table, 1967.

Spray drying dilute suspensions of bentonitic montmorillonite produces a randomly oriented powder that can be handled for specimen loading and forming without decreasing randomness. Electron micrographs show the powder to be composed of thin, crumpled, and rolled films. Extremely small crystallites making up the film are oriented with [001] directions perpendicular to the film surface. Orientation within the plane of the film is random as shown by selected area electron diffraction. Crumpling and rolling of the film is enough to make the orientation random in three dimensions in a large sample. Patterns all show both *hk* and 00*l* diffraction maxima. Line broadening of the 06 and 003 peaks was studied; average crystallite size varied from six to eleven unit layers thick, and average lateral dimension from 140A to 250A.—*from* Authors' abstract

Jones, Gilbert F. *See* Uchupi, Elazar, 06146

00201 **Jordan, James N.; Dunphy, Gerald J.; Harding, Samuel T.** Preliminary seismological report, *in* The Fairbanks, Alaska, earthquakes of June 21, 1967: Washington, D.C., U.S. Environmental Sci. Services Adm., Coast and Geod. Survey, p. 1–32, illus., tables, 1968.

The geologic setting of the Fairbanks area, which was shaken by the earthquakes of magnitude 5.4 to 5.6 on June 21, 1967, on the Yukon–Tanana Upland is reviewed. The Denali fault is south of Fairbanks and must have many parallel faults, although no surficial evidence exists in the region of the shocks; the area is covered by hundreds of feet of alluvium. The Tanana River may be fault controlled on the north and west. Fairbanks earthquakes of July 22, 1937 and Oct. 15, 1947 are described, and locations of large Alaskan earthquakes and those in central Alaska in May 1967 are shown on a map. Equipment installed to study earthquakes in the Fairbanks area for 36 days after the June 21, 1967 earthquake is described. Hypocenters, origin times, and magnitudes are discussed and tabulated along with aftershock frequency and time distribution. Diagrams show focal mechanism; ground amplification studies are reviewed.—ESL

Kaneoka, I. *See* Ozima, M. 00272

Kasper, Andrew. *See* Andrews, Henry N. 00362

06068 **Kaula, W. M.** The Earth from space, *in* The Earth in space (Hugh Odishaw, editor): New York and London, Basic Books, p. 126–135, 1967.

This is a popular account of the theory of determining the shape of the Earth and its density variations by gravitational methods, including use of artificial satellites. The concept of the geoid, heat flow, rotational effects, and the like are summarized.—HRC

05998 **Kavanagh, Paul M.** Have 6,000 years of gold mining exhausted the world's gold reserves?, *in* Pacific Northwest Metals and Minerals Conf., Portland, Oreg., Apr. 1967—Gold and Money Sess., 3d, Proc.: Portland, Oreg., Oregon Dept. Geology and Mineral Industries, p. 1–10, illus. [1967].

The history of gold mining over the last 6,000 years is reviewed to recall where most gold was mined over that period. Reserves around the world are described. In North and Central America, these include placer and lode deposits of the Cordilleran area, the Homestake mine in South Dakota, the new mines in Nevada,

and the Canadian Shield. It is estimated that at the present price, the free world has a gold reserve of 900 million to 1 billion ounces, most of which will be mined by the end of the century. An increase in price would make large additional reserves economical.—ESL

06049 **Kay, Marshall.** On geosynclinal nomenclature: Geol. Mag., v. 104, no. 4, p. 311–316, 1967.

This article is designed to point out the reasons why geologists from different regions, having different experiences, reach conflicting opinions about relationships and terminology, and also some of the history of the origin of some terminology, primarily related to geosynclines. A bit of new historical data is included. Correspondence between Kay and Stille in the late 30's and early 40's is summarized, especially with respect to Stille's use of the geosynclinal nomenclature. Kay also notes that Dana's original definition of geosyncline did not include the mountain-building aspects which are now a part of the definition.—HRC

06218 **Keller, W. D.; Smith, George E.** Ground-water contamination by dissolved nitrate, *in* Relation of geology and trace elements to nutrition—A symposium, New York, 1963: Geol. Soc. America Spec. Paper 90, p. 47–59, illus., tables, 1967.

Ground water containing nitrate in toxic concentrations, occasionally lethal concentrations, has been observed in many states. In Missouri over 5,000 water samples have been tested and range from nil to over 300 ppm nitrogen from NO_3. Forty-two percent were rural and had more than 5 ppm N, a tentative tolerance level for babies. Nitrous waste material is the main source of the contaminant. High nitrate concentrations occur in permeable loess or sandy soil over glacial clay, solution channels in limestone, and low-lying alluvial deposits. Geological knowledge of ground water movement would help in altering the trend toward nitrate poisoning.—*from* Authors' abstract

00270 **Kemp, A. L. W.; Thode, H. G.** The mechanism of the bacterial reduction of sulphate and of sulphite from isotope fractionation studies: Geochim. et Cosmochim. Acta, v. 32, no. 1, p. 71–91, illus., tables, 1968.

The fractionation of sulfur isotopes in the reduction of sulfate and sulfite by the bacteria *Desulphovibrio desulphuricans* has been studied over a wide range of lactate concentration, temperature, electron donor, pH and conditions of growth using resting cell suspensions and cell free extracts of the bacteria. Isotope effects from 5.1 to 23.7 per mille were found for sulfate reduction and 1.7 to 25.5 per mille for sulfite reduction, favoring the lighter sulfur isotope (S 32). These results are discussed in terms of a reaction mechanism involving several consecutive steps, favoring a small or large isotope effect, competing for control of the rate. Also sulfur isotope distribution patterns reported for various types of marine environment and marine sediments are discussed in terms of these isotope effects.—Authors' abstract

06315 **Kemper, W. D.; Shainberg, I.** A reply to G. H. Bolt's "reconsideration" [of "Ion exchange equilibria on montmorillonite", 1967]: Soil Sci., v. 104, no. 6, p. 448–450, 451–453, 1967.

The authors' agree with the need for improvements suggested by Dr. Bolt to their original treatment (ibid., v. 103, no. 1, p. 4–9, 1967), but disagree with the method by which he rationalizes the Boltzmann distribution equations. The development proposed by Bolt results in a cubic equation, whereas that of Shainberg and Kemper is a quadratic equation which is easier to solve and is believed to be correct. This preference for the quadratic equation is further emphasized in a reply to Dr. Bolt's rebuttal.—VSN

Kennedy, J. V. *See* Granquist, W. T. 06111

06109 **Kerns, Raymond L., Jr.; Mankin, Charles J.** Compositional variation of a vermiculite as related to particle size, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 163–177, illus., tables, 1967.

A vermiculite regolith sample from Llano County, Tex., was divided into nine size classes; a well crystallized vermiculite associated with the regolith was ground to 400 mesh. Samples were analyzed by X ray diffractometry and differential thermal analysis, and cation exchange measurements made for selected fractions. Chemical analyses by X ray fluorescence revealed an increase in silicon and iron with decreasing particle size, and a decrease in magnesium; aluminum content was constant throughout. X ray analyses showed that coarser particles were trioctahedral, and smaller, dioctahedral. This was supported by recast formulae based on chemical analyses, and the formulae substantiated by DTA and cation exchange capacity data. These observations are interpreted as an expression of chemical alteration that may occur in an aqueous environment.—*from* Authors' abstract

06306 **Kerr, J. William.** Stratigraphy of central and eastern Ellesmere Island, Arctic Canada—Pt. 1, Proterozoic and Cambrian: Canada Geol. Survey Paper 67–27, pt. 1, 63 p., illus., table, 1967.

Proterozoic rocks, confined to the Franklinian miogeosyncline, include phyllite, limestone and sandstone of the Kennedy Channel Formation, overlain by the Ella Bay dolomite. A wide spread unconformity is considered the base of the Cambrian System. The thick Lower Cambrian Ellesmere Group of alternating coarse and fine clastic formations overlaps southeastward onto the shelf of the Central Stable Region; ollinellids occur near the top. Younger Cambrian rocks are mainly dolomite, the thick Scoresby Bay Formation in the geosyncline and four equivalents, removed from the Thule Group, on the shelf. Middle Cambrian rocks of the geosyncline are all included in the thick, variable Parrish Glacier Formation; on the shelf are the equivalent thin Cape Wood dolomite and lime stone.—GDC

Kerr, P. F. *See* Hausen, D. M. 06279

06269 **Ketcham, W. M.; Hobbs, P. V.** The preferred orientation in the growth of ice from the melt: Jour. Crystal Growth, v. 1, no. 5, p. 263–270, illus., 1967.

An experimental study has revealed the criteria for the orientations of two adjacent ice grains in order that one grain should wedge out the other as growth occurs from the melt by the extraction of heat in one dimension through the ice. Preferred growth occurs only when at least one of the grains can expose the low energy basal plane at the grain boundary. Under these conditions the balance of the surface tension forces produces an asymmetric profile at the grain boundary groove and subsequent growth from the melt leads to the wedging out of one grain. Grains that have their c axis perpendicular to the growth direction are shown to be the preferred crystals.—Authors' abstract

Ketner, K. B. *See* Roberts, R. J. 06397

Keune, R. *See* Hoekstra, P. 06193

06057 **Kier, Porter M.** Revision of the oligopygoid echinoids: Smithsonian Misc. Colln., v. 152, no. 2 (Pub. 4702), 149 p., illus., 1967.

This group, from the Eocene of Florida and the Caribbean area, is considered to have affinities with the clypeasteroids. Considerable detail of their morphology is discussed. The Order Oligopygoidea contains only two genera, *Haimea* and *Oligopygus*. Of the 54 species previously assigned to these two genera, 24 are redescribed, 11 are placed in synonomy, two are transferred to other genera, and one new species is described.—HRC

06174 **Kikkawa, Hideo; Shi-igai, Hiroyoshi; Fukuoka, Shoji.** On the effects of suspended sediments to the bed roughness [with French abs.], Paper A7 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 49–56, illus.; discussion, ibid., V. 5, p. 27–28, 1967.

To express the roughness of flow precisely and systematically for various bed configurations in open channels with movable bed (equilibrium state of sediment transportations), it is shown that by using the logarithmic velocity formula for mean

velocity and removing the effect on roughness due to suspended sediment concentration by means of Kármán's constant variation, the relative (equivalent) roughness can be expressed definitely by the hydraulic characteristics; this relation may be applicable for very fine sand also. However, there may be deviations from the roughness in the equilibrium state, if the flow does not carry enough sediment corresponding to the hydraulic characteristics.—*from* Authors' abstract

00289 **King, Chi-Yu; Knopoff, Leon.** Model seismicity—Rupture parameters, stress, and energy relations: Jour. Geophys. Research, v. 73, no. 4, p. 1399–1406, illus., 1968.

For a sequence of shocks of various sizes generated in a laboratory model of a seismic fault, the potential energy released in a shock is well correlated with the associated rupture parameters of length and displacement. The stress drop associated with a shock increases monotonically with the size of the shock. Tsuboi's hypothesis on the approximate constancy of potential energy density before a shock is found to be valid. A better approximation, however, is to assume that the average stress on the fault immediately before and after the shock is constant. Large shocks, although few in number, are responsible for a large fraction of the total energy release.—Authors' abstract

00364 **King, P. B.** Geologic history of California: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 3, p. 39–48, illus., revised 1968; originally published 1966.

This article was originally published in U.S. Cong., 89th, 2d sess., Comm. Internal and Insular Affairs, Comm. Print (California Div. Mines and Geology Bull. 191, p. 27–34, 1966). Photographs and generalized geologic maps have been added.—ESL

00263 **King, Philip B.; Neuman, Robert B.; Hadley, Jarvis B.** Geology of the Great Smoky Mountains National Park, Tennessee and North Carolina: U.S. Geol. Survey Prof. Paper 587, 23 p., illus., tables, geol. map, 1968.

This summary of geologic investigations by the U.S. Geological Survey and the Tennessee Division of Geology in the Great Smoky Mountains will be useful to students as well as to a wider audience. Bedrock series and major structural features are described. The modern Smoky Mountains are a product of prolonged erosion and uplift and are not themselves a direct product of extensive deformation visible in rocks that compose them. Noteworthy exposures along heavily traveled highways are described and illustrated; a glossary of geologic terms and structure sections are included.—BSH

Kirby, James P. *See* Wilson, Charles W., Jr. 06226

Klein, Howard. *See* Kohout, F. A. 06131

Knopoff, Leon. *See* King, Chi-Yu. 00289

Knudson, Charles F. *See* Cloud, William K. 00167

06195 **Kodama, H.; Schnitzer, M.** Interactions between montmorillonite and a soil humic compound [abs.], *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 257, 1967.

06131 **Kohout, F. A.; Klein, Howard.** Effect of pulse recharge on the zone of diffusion in the Biscayne aquifer [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 252–270, illus., 1967.

In the Miami area, Fla., the salt front is dynamically stabilized about eight miles seaward of the point computed according to the Ghyben–Herzberg principle. When the fresh-water head is low, sea water flows into the zone of diffusion in the deep part of the aquifer, then upward and back to the sea through the upper part. During

periods of heavy rainfall large quantities of fresh water are placed in storage below sea level as high salinity water in the deep part of the aquifer is driven seaward under steep hydraulic gradient. Distortion of the zone of diffusion by this heavy pulse of recharge and return to normal is demonstrated in biweekly mappings of the isochlor pattern subsequent to a 13-in. rainfall. Flow diagrams indicate that the forceful expulsion of salt water after heavy rains results in more efficient recharge than discharge because fresh water is injected into storage throughout the full aquifer thickness.—*from* Authors' abstract

06426 **Konta, J.** Remarks to some terms in the paper "Morphology, internal structure, and origin of glauconite pellets" [D. M. Triplehorn, 1966]: Sedimentology, v. 8, no. 2, p. 169–170, table, 1967.

Triplehorn's paper (ibid., v. 6, no. 4, p. 247–266, 1966) is discussed. Some of the terms used appear to have ambiguities, and a table shows the classification of these features mentioned based upon a distinction between shape and internal and external features.—HRC

Kovach, Robert L. *See* Anderson, Don L. 06411

00327 **Krieger, Medora H.** Geologic map of the Brandenburg Mountain quadrangle, Pinal County, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-668, scale 1:24,000, sections, separate text, 1968.

Map units described in the text include surficial deposits, Pliocene conglomerate, Miocene volcanics, Cambrian through Pennsylvanian sediments, and Precambrian quartzites and igneous rocks.—MCM

00328 **Krieger, Medora H.** Geologic map of the Holy Joe Peak quadrangle, Pinal County, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-669, scale 1:24,000, sections, separate text, 1968.

Map units are described in the text and include surficial deposits, Pliocene conglomerate, Miocene volcanics, Mesozoic sediments and some volcanics, Paleozoic sediments, and Precambrian sediments and intrusives.—MCM

00268 **Kriz, George J.; Scott, Verne H.; Burgy, Robert H.** Analyses of parameters of an unconfined aquifer—Closure [to discussions of paper 4901, 1966]: Am. Soc. Civil Engineers Proc., v. 94, paper 5825, Jour. Hydraulics Div., no. HY2, p. 556, 1968.

The contributions of those discussing the original paper [ibid., v. 92, no. HY5, p. 49–56, 1966] are greatly appreciated. The new function defined by Monkmeyer and Murray illustrates the similarity between the confined aquifer solution and that for the unconfined proposed by Kriz; major difference is that the decreasing depth of flow is accounted for in the unconfined case and is considered constant in the confined case.—ESL

06194 **Krizek, Raymond J.; Franklin, Arley G.** Viscoelastic shear response of a kaolinite, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 227–240, illus., 1967.

The fact that clays exhibit both viscous and elastic response characteristics has led to use of the viscoelasticity theory for describing their mechanical behavior. A brief outline of pertinent concepts from this theory establishes a framework for presentation and interpretation of results of experiments conducted on a water washed Georgia kaolin at moisture contents of 50, 75, and 100 percent, including oscillatory shear tests over a frequency range of two decades. Testing was done on a Weissenberg Rheogoniometer with a cone-and-plate sample holder, which produces homogeneous shear strains. Results show that stress-strain response of the clay is frequency-dependent and nonlinear, even at small strains. The greatest frequency dependence occurs in a region characteristic of many polymer systems. The logarithm of the complex shear modulus is found to vary approximately as the water content.—*from* Authors' abstract

Krouse, R. H. *See* Folinsbee, R. E. 06286

Krummel, W. J., Jr. *See* Hinrichs, E. N. 00333

Ku, Teh-Lung. *See* Broecker, Wallace S. 00211

Kullerud, G. *See* Naldrett, A. J. 06044

00349 **Kumai, Motoi.** Hexagonal and cubic ice at low temperatures: Jour. Glaciology, v. 7, no. 49, p. 95–108, illus., 1968.

Formation of hexagonal and cubic forms of ice was studied by use of a cold stage in an electron microscope in the temperature range −90° to −180°C. Ice crystals were made on cold substrates, i.e. collodion film, gold foil, or copper grid on the specimen holder of the cold stage. Hexagonal forms of ice formed on the cold substrates at temperatures from −90° to −100°C. At −100°C to −130°C, both hexagonal and cubic forms of ice were detected. From −130° to −160°C only cubic ice was found; below −160°C, minute crystals of cubic ice were detected. No transformation of the structural forms occurred when the temperature was varied in the range −90° to −160°C. Lattice constants of hexagonal and cubic ice, and the coefficient of thermal expansion of ice were calculated from the experimental results.—*from* Author's abstract

00375 **Kunkle, George R.** A hydrogeologic study of the ground water reservoirs contributing base runoff to Four Mile Creek, east central Iowa: U.S. Geol. Survey Water Supply Paper 1839-O, p. O1–O41, illus., table, 1968.

The base flow comes from a system of two interconnected reservoirs, one of upland loess, and the other of bottom land alluvial sand, which occupy the entire 19.5 sq mi watershed. The loess is a water table reservoir, 5–12 feet in saturated thickness, which drains to tributaries or to the alluvial sand semiartesian reservoir averaging 15 feet thick. Both reservoirs leak to an underlying till; the water moves down into Devonian limestone and is drained off by buried channels. Base flow discharge from the loess in 1963–64 averaged 0.2 in.; about 1.4 in. per yr was lost to bedrock. Discharge from the alluvial sand accounted for 37–42 percent of the annual base flow, so that base flow characteristics of Four Mile Creek are related principally to this reservoir.—*from* Author's abstract

06412 **Kushiro, I.; Syono, Y.; Akimoto, S.** Stability of phlogopite at high pressures and possible presence of phlogopite in the Earth's upper mantle: Earth and Planetary Sci. Letters, v. 3, no. 3, p. 197–203, illus., table, 1967.

High-pressure experiments have been made on the stability of natural and synthetic phlogopites from 41 to 96 kb and from 1030° to 1680°C. Phlogopite breaks down to garnet and unidentified minerals at pressures above 40 kb at about 1200°C. The garnet formed by the breakdown of phlogopite most likely contains about 5 wt. percent K_2O. Phlogopite could be a possible K-bearing mineral in the upper mantle down to 150–200 km in the continental areas; deeper, garnet may be a possible K-bearing mineral. At shallower levels (less than 100 km) amphibole may be a K-bearing mineral instead of or in addition to phlogopite. Kimberlites and some K-rich basalts may be formed by the partial melting of the phlogopite-bearing peridotites of the upper mantle.—*from* Authors' abstract

06299 **Kvammen, Kenneth R.** The role of local jurisdictions in efficient use and development of marine resources, *in* The new thrust seaward—MTS Conf. and Exhibit, 3d Ann., San Diego, Calif., 1967, Trans.: Washington, D. C., Marine Technology Soc., p. 11–22, 1967.

In reaping benefits provided by marine resources, local jurisdictions often become lost in the shuffle or stampede of concerned Federal, State, commercial, and academic agencies; this should not and need not be the case. Historic and current procedures, methods, and technology of Los Angeles County in studying, developing and managing its shore and offshore resources is described, as are resulting practical and concrete benefits. This local agency experience is related to the vast potential of the numerous local jurisdictions along the seacoasts of the United States and

its territories—a potential which could contribute to urgent needs in furthering ocean science. Responsibility for this effort lies primarily with local jurisdictions.—*from* Author's abstract

Lacoss, Richard T. *See* Toksöz, M. Nafi. 00174

06048 **Lafferty, William R.** The gamma ray logger as a geologic tool in the coastal plain of South Carolina: South Carolina Div. Geology Geol. Notes, v. 11, no. 4, p. 55–58, illus., 1967.

A small portable gamma-ray logging device which can be used in existing water wells is described, as is the theory of gamma-ray logging. No specific examples are cited, however.—HRC

Laguros, Joakim G. *See* Papadopoulos, George T. 00194

06151 **Lake, Richard H.** The construction, operation and performance of an equipment for differential thermal analysis [with French abs.]: Canada Dept. Energy, Mines and Resources Mines Br. Tech. Bull. TB 92, 42 p., illus., table, 1967.

A description is given of an equipment for use in differential thermal analysis. The equipment, which was designed and built in the Mines Branch, is capable of operating at high sensitivity and stability at temperatures up to 1600°C in air or in any controlled atmosphere at 1 atm. pressure, or in vacuum up to 1250°C. Details are given of the engineering specifications of the components and of precautions to be taken in order to obtain satisfactory operation. Typical DTA curves, showing the types of result that can be obtained with the equipment, are included. Possible sources of supply of the various components are quoted.—Author's abstract

Lakner, J. F. *See* Giardini, A. A. 00287

06006 **Lamar, D. L.; Merifield, P. M.** Cambrian fossils and origin of Earth-Moon system: Geol. Soc. America Bull., v. 78, no. 11, p. 1359–1367, illus., table, 1967.

Analysis of available data on the lunar torque and the mechanism and rate of tidal dissipation and studies of growth lines on Paleozoic corals imply that the Moon became an Earth satellite between 0.5 and 2.0 b.y. ago. Origin of the Earth-Moon system by noncatastrophic methods of capture at a distance or aggregation of several small moons is suggested. Shallow-marine invertebrates would have been affected by the greatly increased tidal ranges and tidal currents and the introduction of a lunar light cycle; a causal relation with the appearance of hard-shelled marine organisms in Lower Cambrian strata is conceivable. Protective exoskeletons would be an adaptive characteristic for shallow-water bottom-dwellers suddenly confronted with powerful tides.—*from* Authors' abstract

06272 **Lang, W. J.** The influence of pressure on the electrical resistivity of clay-water systems, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 455–468, illus., 1967.

The influence of pressure on resistivity of clay-water systems reflects the abnormal nature of adsorbed water. Resistivity of montmorillonite-water systems varied with pressure like a dilute salt solution above 7000 psi; below this, abnormal pressure-resistivity relations resulted, due to abnormal water adsorbed on clay minerals. Pressure-induced breakdown of abnormal water associated with montmorillonites occurred in abrupt stages showing that layers of adsorbed water have differing degrees of structural bonding by which variations of the water-orientating ability of clay minerals may be compared. Ca-montmorillonite allowed the most rigid bonding of adsorbed water while Na-montmorillonite showed the most extensive development. Abnormal water re-formed with some hysteresis effects when pressure was released. Increase in temperature was found to decrease both amount and relative strength of the abnormal water.—ESL

Langway, C. C., Jr. *See* Hamilton, W. L. 00321

Larson, E. E. *See* Eggler, D. H. 00369

06207 **Larson, Lawrence T.** Mineral resources summary of the Chewalla quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 4 p., 1967.

Mineral resources mined in the Chewalla quadrangle are sand and gravel, and a mixture of sand, silt, and clay in the McNairy Sand which is about 265 feet thick at the west edge of the area. Fluvial deposits consist of sand, silt, clay, and gravel, which locally are as much as 30 feet thick. A potential resource is heavy-mineral sand. This text accompanies Tennessee Div. Geology Geol. Map GM 4-SW, by E. E. Russell (cited separately).—MCM

06114 **Lau, L. S.; Mink, J. F.** A step in optimizing the development of the basal water lens of southern Oahu, Hawaii [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 500–508, illus., 1967.

The city of Honolulu obtains its fresh water supply almost entirely from a Ghyben-Herzberg lens that underlies the southern portion of Oahu. Many small communities and military bases derive their water from the same source so that an average of about 100 mgd of low salinity fresh water is pumped from the lens for domestic use. The largest developments, however, serve agriculture which utilizes up to 150 mgd. Recently the city planned a new pumping station designed to withdraw 10 mgd from the lens. Test results demonstrated that use of four wells located at least 4,500 feet inland from the Kalauao Springs spaced at least 50 feet apart, discharging into Pearl Harbor, and drilled to a depth of about 100 feet below sea level was hydrologically desirable.—ESL

Lauffer, James R. *See* Enman, John A. 06037

Lee, F. T. *See* Scott, J. H. 00376

06413 **Lee, G. Fred; Hoadley, Alfred W.** Biological activity in relation to the chemical equilibrium composition of natural waters, [Chap.] 16 *in* Equilibrium concepts in natural water systems—Am. Chem. Soc., 151st Ann.Mtg., Pittsburgh, 1966, Water, Air and Waste Chemistry Symposium: Washington, D.C., Am. Chem. Soc. (Adv. Chemistry Ser. 67), p. 319–338, illus., table, 1967.

For many elements, the concentration of a species in a given body of water can be predicted by abiotic chemical reactions such as protolysis, precipitation, complexation, redox, and sorption. Aquatic organisms can influence the concentration of compounds directly by metabolic uptake, transformation, storage, and release. Aquatic organisms may also cause chemical reactions by changing the concentrations of solutes which are important in abiotic equilibria. The two most important reactions of this type are change synthesis and the uptake and release of organic compounds. Both of these reactions can influence acid-base, precipitation, complexation, redox, and sorption reactions in natural waters.—Authors' abstract

06312 **Leighton, F. Beach.** Gold Butte vermiculite deposits, Clark County, Nevada: Nevada Bur. Mines Rept. 16, 18 p., illus., tables, geol. map, 1967.

These deposits occur in Precambrian ultramafic rocks within a square-mile area in the South Virgin Mts. Peridotites and perknites, that intruded migmatites and other hybrid gneisses, now crop out within an elliptical dome, with augen gneiss in a transitional zone. Hydrothermal solutions associated with granitic pegmatites are believed to have distributed the vermiculite in veins, stringers, pockets, and scattered flakes; the process was continued later by meteoric waters. Optical, chemical, X-ray, and differential thermal data indicate two types of vermiculite-biotite mixtures: one interstratified in a ratio of 2 to 1, the other essentially biotite containing 4 percent vermiculite. Considerable variation in ratio exists in a single vein; vermiculite evidently altered from biotite. The deposits have economic possibilities.—GDC

06294 **Leo, Gerhard W.** The plutonic and metamorphic rocks of the Ben Lomond Mountain area, Santa Cruz County, California, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 91, p. 27–43, illus., table, geol. map, 1967.

The crystalline core of this mountain is an irregularly shaped mass with a 40-sq mi exposure, surrounded by Tertiary sedimentary rocks. Plutonic rocks of the complex comprise several distinct intrusions ranging from gabbro to granite in two periods. The first, synkinematic with deformation and high-grade regional metamorphism, resulted in gneissic stocks. A subsequent plug of gabbro was followed by the Ben Lomond pluton of quartz diorite; both imposed thermal metamorphism on the pre-existing rocks. Mineral assemblages and structures of the metamorphic rocks are briefly described. The Ben Lomond Mtn. complex may be equivalent to crystalline rocks of the Santa Lucia Range; K-Ar age determinations on the granitic rocks indicate Late Cretaceous intrusions.—GDC

06108 **Leonard, R. A.; Weed, S. B.** Influence of exchange ions on the *b*-dimensions of dioctahedral vermiculite, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 149–161, illus., tables, 1967.

Ground muscovites were treated for 30 days for K^+ removal with a pH 7.5 solution containing sodium tetraphenylboron; final K contents ranged from 21–37 me/100g. Apparent structural charge on the expanded material decreased to values ranging from 156–184 me/100g, within charge range for natural vermiculites. The *b* dimensions of these synthetic vermiculites were found to vary with the exchange ion and its hydration state. For hydrated samples, saturation with Cs^+, Li^+, and Mg^{++} ions increased the *b* dimension in comparison to parent mica; after dehydration, only Cs^+ saturated samples had a *b* dimension greater than the parent, and the *b* dimension was found to be a direct function of the crystal radius of the interlayer ion. As it dehydrates, surface oxygen triads rotate until some of the oxygens lock onto the ion, limiting the minimum *b* dimension.—*from* Authors' abstract

Leonard, R. A. *See* Weed, S. B. 06184

00213 **Lerman, Abraham; Stiller, Mariana; Hermon, Erica.** Mössbauer quantitative analysis of Fe^{+3}/Fe^{+2} ratios in some phosphate and oxide mixtures—Possibilities and limitations: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 409–416, illus., tables, 1967 [1968].

Ratios of the peak areas on Mössbauer spectra of mixtures of vivianite and amorphous ferric phosphate vary linearly with the ratios of the proportions of the phases. The results of the Mössbauer analysis agree to within 3 percent with conventional chemical methods. Interpretation of the Mössbauer spectra of iron phosphate mixtures and oxidized vivianite is consistent with magnetic susceptibility measurements. Consideration of the spectra of a number of ferrous and ferric phosphates and oxides indicates that the Mössbauer analysis may also be applied to some phosphate-oxide mixtures. For a reasonably accurate estimation of the Fe^{+3}/Fe^{+2} ratio in mixtures of minerals, calibration curves may need be constructed for each particular case.—*from* Authors' abstract

00261 **Lesure, Frank G.** Mica deposits of the Blue Ridge in North Carolina: U.S. Geol. Survey Prof. Paper 577, 124 p., illus., tables, geol. map, 1968.

Pegmatites in the Blue Ridge of North Carolina are important sources of mica, feldspar, kaolin, and quartz. The principal pegmatite minerals are oligoclase, perthitic microcline, quartz, and muscovite. Biotite and garnet are minor accessories; other minerals are rare. Most of the pegmatites are tabular bodies and about half are discordant with the foliation of enclosing mica and hornblende gneiss and schist. The pegmatites occur throughout the area where the metamorphic intensity reached at least the kyanite-muscovite subfacies of the amphibolite facies; they are concentrated in the Spruce Pine and Franklin-Sylva districts. Descriptive data are presented in tabular form for 1,350 deposits. Reserves of scrap mica, feldspar, and clay are extensive; reserves of sheet mica cannot be calculated.—FGL

Li, Yuan Hui. *See* Broecker, Wallace S. 06232

Lindemann, W. L. *See* McBride, E. F. 00346

00205 **Linn, T. A., Jr.; Moore, C. B.** Neutron activation determination of gold in iron meteorites and inclusions: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 453–456, illus., tables, 1967 [1968].

The concentrations of gold in 19 iron meteorites have been determined via neutron activation analysis. The upper limits of gold concentrations in 10 sulfide nodules and in one phlogopite inclusion were also established. Gold concentrations range from 0.2 ppm in the metal. The sulfide nodules and phlogopite inclusions show limiting concentrations of about 0.1 ppm gold.—Authors' abstract

06149 **Logan, A.** Middle and Upper Triassic spiriferinid brachiopods from the Canadian Arctic Archipelago [with French abs.]: Canada Geol. Survey Bull. 155, 37 p., illus., 1967.

Late Middle Triassic (Ladinian) and early Upper Triassic (Karnian) spiriferinid brachiopods are recorded from the Schei Point and Blaa Mountain Formations of Ellesmere and Table Islands, Northwest Territories. *Spiriferina (Spiriferina) ellesmerensis* n.sp. of Ladinian age and *S. (Rastelligera) canadensis* n.sp. of Karnian age are described. Preservation of unaltered shell microstructures in the latter species permits detailed morphogenetic analysis of the internal structures of both valves. A Himalayan species of Karnian age and a Spitzbergen species of Ladinian–Karnian age are also recognized in the Canadian formations. Validity of the subgenus *Rastelligera* Hector is confirmed and the taxon is reserved for those species that possess a denticulate hinge margin.—*from* Author's abstract

06401 **Loncarevic, B. D.; Ewing, G. N.** Geophysical study of the Orpheus gravity anomaly [with French abs.]. *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 827–835, illus., 1967.

Marine geophysical investigations on the eastern seaboard of Canada show an extensive belt of large negative gravity anomalies, which have been named "Orpheus." The anomaly extends from the entrance of Chedabucto Bay in the west and trends in a straight line to the southwest wall of the Laurentian Channel. The same gravity trend continues across the Laurentian Channel, with isolated negative anomalies reaching a minimum of –60 mgal within it. The free-air anomaly is continuous within the –20 mgal contour for a distance greater than 325 km. The Orpheus gravity anomaly and postulated causative bodies can be related to known geology of the nearby mainland. Methods of shipborne gravimeter surveys and their accuracy are discussed.—*from* Authors' abstract

Long, Austin. *See* Hattersley-Smith, G. 06053

Longenbaugh, R. A. *See* Bittinger, M. W. 06115

06039 **Lounsbury, John F.** Earth science in education: Pennsylvania Geographer, v. 5, no. 4, p. 1–4, 1967.

At the turn of the century, courses in earth sciences were common in high school, but interest declined until, by 1950, only one percent of the students were taking such a course. In the last ten years, there has been a great re-emphasis on earth science. An attempt is made to define earth science as a field which integrates material from various disciplines. Programs to train high school earth-science teachers are being developed in many higher institutions. Earth science courses should be offered in college as every well-educated person should have some knowledge of the physical world in which he lives.—ESL

Lovell, H. L. *See* Rupert, R. J. 00191

Lovell, H. L. *See* Rupert, R. J. 00192

06437 **Lucia, F. Jerry; Murray, Raymond C.** Origin and distribution of porosity in crinoidal rock [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 409–423, illus., 1967.

The porosity history was studied in thin sections and on distribution charts for three different crinoidal carbonate reservoirs. The Mississippian Chester oolite in northwestern Oklahoma is an example of relict primary porosity in a current transported sand. The Andrews South field (Devonian) of Texas represents secondary porosity by dissolution of interparticle lime mud and some dolomitization, the purer limestone facies being less productive. The Harmattan field (Mississippian) of Alberta is a case of high porosities and permeabilities in a dolomite derived from lime sand and lime mud with scattered crinoid fragments, with a relict patch of limestone being non productive. Once the cause of porosity in a given area is understood, it is often possible to predict the distribution of rock with good reservoir properties.—KAR

Lum, Daniel. *See* Cook, Kenneth L. 06289

06000 **Lundgren, Lawrence, Jr.** The bedrock geology of the Old Lyme quadrangle (with map): Connecticut Geol. and Nat. History Survey Quad. Rept. 21, 30 p., illus., tables, geol. map, 1967.

In this area, the following metamorphic bedrock units range in age from Cambrian(?) to Silurian: Plainfield and Mamacoke Formations, Ivoryton Group, Tatnic Hill and equivalent Brimfield Formations, and Hebron Formation. Granitic gneisses, the Sterling Plutonic Group, are interleaved with the oldest two formations; discordant granites, Westerly and Black Hall types, cut them. The discordant granites are Permian(?); the concordant Sterling Group Devonian(?) or older. Rocks above the Ivoryton occur in the Hunts Brook syncline, isoclinal between two domes, its axial surface folded around the Lyme dome. All rocks, other than in the Selden Neck dome and the younger discordant granites, are now sillimanite–orthoclase subfacies of the almandine amphibolite facies, metamorphosed at over 600°C. GDC

Luternauer, John. *See* Pilkey, Orrin H. 06373

06043 **Luth, W. C.** Studies in the system $KAlSiO_4$–Mg_2SiO_4–SiO_2–H_2O—[Pt.] 1, Inferred phase relations and petrologic applications: Jour. Petrology, v. 8, no. 3, p. 372–416, illus., tables, 1967.

The results of synthesis experiments in this system have been used to outline the melting and subsolidus phase relations at temperatures from 700° to 1200°C and pressures to 3 kilobars, providing a framework for discussing petrologic features of near surface potassic rocks, some lamprophyres, charnockitic granites, kimberlites, and allied mica peridotites; the pressure–temperature stability limits of coexisting phases are considered. The bivariant phase relations may provide a means to account for the olivine to biotite and pyroxene to biotite reaction relations observed in potassic rocks, and a mechanism for crossing the joins forsterite–potash feldspar and enstatite–potash feldspar from the silica–undersaturated to the silica–oversaturated region. The petrologic importance of water–undersaturated magmas is stressed.—GDC

06387 **Lydon, Philip A.** The origin of Tuscan Buttes and the volume of the Tuscan Formation in northern California, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 91, p. 17–26, illus., 1967.

Tuscan Buttes, two hills rising 500 feet above flat-topped ridges northeast of Red Bluff in Tehama County, intrude the upper Pliocene Tuscan Formation of tuff breccia and subordinate tuff, sand, and gravel that spread widely from eruptive centers in the southernmost Cascade Range. The Buttes are shown by detailed mapping to be volcanic plugs, surrounded by breccia that sloughed off them as they rose. An estimated 250–cubic–mile volume for the Tuscan Formation (Lydon, 1961) is based on a contour plot of its exposed thickness. One assumption, that its surface was lowered only slightly by erosion, is supported by the present

conclusion that Tuscan Buttes are not remnants of a 500 ft thickness of surrounding rock as reported by Anderson (1933).—GDC

06134 **Maasland, D. E. L.; Bittinger, M. W.** Drainage of a saline water aquifer recharged by fresh water [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 350–359, illus., 1967.

The effluent from drains in a saline water aquifer, being recharged with fresh water, consists of a mixture of salt and fresh water. A Hele Shaw model study was conducted to determine the rate of quality change of drain effluent for various conditions of drain spacing, thickness of aquifer, permeability, and recharge rate. Three aquifer conditions were studied: (1) a uniform aquifer, (2) a layered aquifer (top layer 12 times as permeable as the bottom), (3) a layered aquifer (bottom layer 6 times as permeable as the top). Results are presented in the form of dimensionless charts, containing the variables drain spacing, thickness of aquifer, permeability, recharge rate, and porosity. The charts enable the user to predict the salt concentration of the drain effluent at any time for various magnitudes of the aforementioned variables.—Authors' summary

Macdonald, Frank. *See* Waugh, Harry, 06302

06247 **Macdonald, Gordon A.** Forms and structures of extrusive basaltic rocks, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 1–61, illus., tables, 1967.

A description and genetic discussion of various types of features of lava flow and tephra are given. Included are flows of all sorts, such as pahoehoe, aa, block lava, avalanches, mudflows, pillow lavas and hyaloclastics, and lava flows in deep waters; also discussed are tumuli, pressure ridges, squeeze-ups, slump scarps, top and bottom features, and flow direction criteria. Considerable space is given to pyroclastic material, including the various types of cones.—HRC

06080 **MacDonald, Gordon J. F.** The origin of the solar system, *in* The Earth in space (Hugh Odishaw, editor): New York and London, Basic Books, p. 3–13, 1967.

In order to analyze the history of development of the highly organized solar system observable today, it is necessary to have a detailed understanding of the unique features of each planet and of how individual members of the system interact with other members and of the long-term consequences. Moreover, in any theory of origin of the solar system the relation between angular momentum and mass for many objects and the failure of the Sun to conform must be explained. The Sun contains almost all the mass of the system whereas the planets possess nearly all the angular momentum; possible explanations are considered. In addition such problems as the stability of the planets and of their satellite systems with respect to tidal friction interaction are examined.—VSN

00193 **MacKenzie, D. B.** Studies for students—Sedimentary features of Alameda Avenue cut, Denver, Colorado: Mtn. Geologist, v. 5, no. 1, p. 3–13, illus., 1968.

This is a guidebook for a field trip through the canyon west from the center of Denver into the Front Range. Ripple marks, dinosaur footprints, channel filling features, other tracks and trails, and tidal flat features in the Dakota Sandstone are described. Very generalized descriptions for the untrained, and very detailed descriptions for the professional geologist are included.—HRC

06102 **Macqueen, R. W.; Bamber, E. W.** Stratigraphy of Banff Formation and lower Rundle Group (Mississippian), southwestern Alberta: Canada Geol. Survey Paper 67–47, 36 p., illus., 1967.

In southwestern Alberta, two distinct, correlative rock sequences are developed in the Lower and Middle Mississippian succession. These sequences constitute an eastern facies, which includes the Banff, Pekisko, Shunda, and Turner Valley Formations, and a western facies which includes the Banff and Livingstone

Formations. In the western facies, the Banff–Livingstone contact does not appear to change in age between Mount Rundle, to the north, and the Mount Head map-area, to the south. Evidence from lithologic and faunal observations, spatial relationships, and environmental considerations demonstrates that the Pekisko, Shunda, and Turner Valley Formations of the eastern facies pass laterally into the Livingstone Formation of the western facies. No evidence has been found for correlation of the Shunda Formation with the upper member of the type Banff Formation.—Authors' abstract

00269 **MacQuown, W. C., Jr.** Geologic map of the Clintonville quadrangle, central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–717, scale 1:24,000, section, text, 1968.

One barite vein, three inches thick, was observed in the southwestern part of the Clintonville quadrangle. The Tyrone lies 150–200 feet below the surface, but the Tanglewood Limestone Member of the Lexington has been quarried in the past for local road metal, agricultural lime, and building stone. Phosphate rock occurs in minor amounts in residual soil of the Tanglewood Member, but is not known to be present in commercial quantities. Minor occurrences of oil in vugs and fault breccia have been observed and a show of gas with light oil stain was obtained from the Tanglewood. Water resources are partly dependent on porosity and permeability of the formations underlying the soil.—MCM

Magomedova, A. V. *See* Mirtskhulava, Ts. E. 06157

Mankin, Charles J. *See* Kerns, Raymond L., Jr. 06109

Mankin, Charles J. *See* Bellis, William H. 06202

06240 **Manson, Vincent.** Geochemistry of basaltic rocks—Major elements, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 215–269, illus., tables, 1967.

An empirically-determined chemical screen provides a chemical definition for basalts that was used to select, from 4,300 samples, 1,996 superior analyses of rocks of basaltic composition. Factor analysis enables the representation of the overall chemical variation in terms of four end members. The chemistry shows essentially complete gradation over the range of basaltic rock types. The major variations observed are not consistent with chemical changes resulting from crustal crystal fractionation. It is concluded that, although the chemistry of alkali basalt is gradational with tholeiite, compositional changes in the products of partial melting of the upper mantle account for the variations between these basaltic rock types.—*from* Author's conclusions

06422 **Marmo, Vladimir.** On the granite problem: Earth-Sci. Rev., v. 3, no. 1, p. 7–29, 1967.

This paper is a review of the evolution of theories concerning the origin of granites from 1800 up to recent days.—Author's summary

Martin, Charles W. *See* Gates, Robert M. 06098

00331 **Mason, Brian.** Pyroxenes in meteorites: Lithos, v. 1, no. 1, p. 1–11, illus., 1968.

Meteoritic pyroxenes, while analogous in many respects to those from terrestrial rocks, show some unique features. Among these are the presence of minerals close to $MgSiO_3$ in composition, the common occurrence of minerals belonging to the clinoenstatite–clinohypersthene series, the rarity of calcium-rich and aluminium-rich pyroxenes, and the absence of jadeitic varieties. Shock effects are prominent in some meteorites, and have resulted in the inversion of orthypyroxene to clinopyroxene of essentially the same composition. In many chondrites orthopyroxene has been formed from low-calcium clinopyroxene by thermal metamorphism. Coexisting orthopyroxene and diopside in most chondrites and in

silicate inclusions in irons indicate equilibration temperatures below 900°C.—Author's abstract

06267 **Mason, Brian.** Meteorites: Am. Scientist, v. 55, no. 4, p. 429–455, illus., tables, 1967.

This paper, based upon a Sigma Xi lecture-tour address, is a complete summary of the knowledge of meteorites to date, expressed in nontechnical, semipopular terms. It discusses history, recovery, composition and classification, organic compounds, chronology, and origin of meteorites.—HRC

06423 **Masuda, Akimasa.** Lanthanide concentration ratios between pyroxene and garnet: Earth and Planetary Sci. Letters, v. 3, no. 1, p. 25–28, illus., 1967.

Consideration of curves of La concentration in pyroxene and garnet determined by Frey (1966) and by Schnetzler and Philpotts, along with information regarding equilibrium conditions of lanthanum at various temperatures and pressures, produces the conclusions that the chemical bond of the lanthanide cation with surrounding oxygen anions would be tighter in garnet than in pyroxene.—HRC

Matthews, R. K. *See* Broecker, Wallace S. 00211

05989 **Maughan, Edwin K.** Pennsylvanian and Permian paleogeography, tectonics, and stratigraphy in Montana and the Dakotas [abs.], *in* Symposium on recently developed geologic principles and sedimentation of the Permo-Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf. 1966: Casper, Wyo., Petroleum Inf., p. 95–108, illus. [1967?].

May, George D. *See* Charmonman, Srisakdi. 06135

Mazor, E. *See* Heymann, D. 00297

00353 **McBirney, Alexander R.** Second additional theory of origin of fiamme in ignimbrites: Nature, v. 217, no. 5132, p. 938, table, 1968.

Regardless of pumice content, ignimbrites with prominent horizons of glassy clots (fiamme) seem to be restricted to areas directly underlain by coarse fluvial sediments. Chemical analyses of the fiamme and host rock of a Miocene ignimbrite from northwestern Nicaragua are almost identical. In the fiamme the water content is higher, the iron more reduced, and the K/Na ratio slightly higher. The clot is not an uncontaminated glass of the same generation as the shards. It is suggested that the fiamme were formed after the ignimbrite came to rest over water-saturated sand and gravel. The interior absorbed water vapor streaming up through the fractured, chilled base; the water content became high enough to depress the melting point until it intersected the steep temperature gradient, and first the low-melting portion of the rock and then the incorporated xenolithic fragments were remelted.—DBV

00346 **McBride, E. F.; Lindemann, W. L.; Freeman, P. S.** Lithology and petrology of the Gueydan (Catahoula) Formation in south Texas: Texas Univ. Bur. Econ. Geology Rept. Inv. 63, 122 p., illus., tables, 1968.

The term Gueydan (Bailey, 1926) is used here because the lithology is significantly different from the Catahoula strata to the east; stratigraphic terminology is tabulated. The formation is chiefly tuffaceous clay with lesser volcanic arenite, conglomerate, bentonite, vitric tuff, and a few beds of vitric ash. The petrography is described; 28 plates show outcrops and photomicrographs. The rocks are derived from volcanic and hypabyssal intrusives, and were probably deposited during Oligocene to early Miocene time. Sandstone and conglomerate are fluvial bar and channel deposits. Complex diagenetic changes in texture and mineralogy of all beds took place. Nine measured sections are given in Appendix A, and descriptions of igneous rocks as seen in 11 thin sections in Appendix B.—ESL

McCallum, K. J. *See* Campbell, C. A. 06265

McClure, Lavere W. *See* Enman, John A. 06037

McConnell, R. K., Jr. *See* Aronson, J. R. 06366

06449 **McCulloh, Thane H.** Borehole gravimetry—New developments and applications [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 735–744, illus., 1967.

In 1965 and 1966 two dissimilar borehole gravimeters having precisions close to 0.01 milligal were developed. Depth-measurement precisions from 3 to 6 cm permit overall precisions of 0.1–0.02 mgal in gravity determinations in cased wells. Use of such high precisions requires corrections for differential effects of nonvertical holes, systematic and unsystematic depth measurement errors, surface terrain, casing irregularities, and instrumental response to large ambient temperature ranges. Borehole gravimetry is useful for studies of density, porosity, and fluid character. A borehole gravimetric density and porosity profile of a clastic Pleistocene–Pliocene section is in excellent agreement with laboratory measurements of conventional cores. Underground and surface gravity and geologic data for the residual gravity minimum of Santa Fe Springs oil field illustrate the potential exploration value of borehole gravimetry.—*from* Author's abstract

06453 **McDonal, F. J.; Sengbush, R. L.** Geological data processing to resolve fine subsurface detail [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 585–597, illus., 1967.

A linear filter model of the seismic reflection process provides a basis for interpreting the field seismogram in terms of fine subsurface detail. The synthetic seismogram is prepared within the framework of this model, and provides the link between the seismogram and the interpretation of geological features such as pinchouts, facies changes, sand lenses, reefs, etc. This paper extends the concept of the linear filter model to include the elimination of distortion associated with reverberations, ghosts, and also the changes in shot pulse waveform (and frequency content) that occur from record to record. Some types of multiple reflections can be minimized by similar techniques, but results for this case have been less outstanding than for ghosts and water reverberations.—Authors' summary

McGregor, A. A. *See* Gary, Samuel. 00168

06378 **McGuinness, C. L.** Ground water research in the U.S.A.: Earth Sci. Rev., v. 3, no. 3, p. 181–202, tables, 1967.

Ground water reservoirs and the overlying unsaturated zone have an enormous capacity, which can be exploited on a maximum scale only on the basis of information one or more orders of magnitude greater than that available at present. Because usable water must be made available, and waste water must be disposed of, at costs of only a few cents per cubic meter, there is a critical need for research to devise methods of accomplishing this. Chief target areas for research in subsurface hydrology are permeability distribution; prediction of the departure of the storage coefficient from the theoretically instantaneous property assumed in flow equations; theory of unsaturated flow based on soil characteristics that can be measured; geochemical relations including waters of different composition, acid mine water, and occurrence of saline water; wastes injected underground; geophysical techniques; and practical techniques of artificial recharge.—*from* Author's abstract

McIntyre, D. B. *See* Baird, A. K. 06389

06435 **McIver, Richard D.** Composition of kerogen—Clue to its role in the origin of petroleum [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 25–36, illus., tables, 1967.

Analysis of the elemental composition of kerogens shows that the term kerogen refers to a wide variety of mixtures. Important controls on the composition of

kerogen appear to be the environment of deposition and source of the organic matter, and the extent of maturation of the material. Products of maturation probably include large quantities of CO_2, water, and hydrocarbons. Any shale or fine grained rock that contains organic matter of any kind is a potential source of hydrocarbons. If it contains a few tenths of a percent of organic matter, it is a potential source of commercial quantities of oil and gas. The amount of hydrocarbon that a kerogen can generate is a function of its original structure and hydrogen content, and to a lesser extent its oxygen content.—KAS

00308 **Melton, Frank A.** Regional unconformities of flatlands: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 313–321, illus., 1968.

Simplified regional stratigraphic map diagrams are useful in the study of onlap and strike overlap at known regional unconformities in the coastal plain and low-dip "strata-benchlands," especially in marginal cratonic and shelf areas. Certain basic simplifying assumptions are presented.—WCC

Mencher, Ely. *See* Andrews, Henry N. 00362

00207 **Mereu, R. F.** Curvature corrections to upper mantle seismic refraction surveys: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 469–475, illus., tables, 1967 [1968].

Most upper mantle and crustal velocity determinations are made using conventional seismic refraction techniques under the assumption that the Earth may be considered flat for distances up to about 1500 km. The flat Earth assumptions, however, lead to systematic errors which take the following forms: (a) apparent velocity determinations are too large, and are a function of the refractor depth; (b) apparent "lateral variations" in the upper mantle are produced; (c) refractor depth calculations depart from correct values as the depth is increased beyond 60 km; (d) misleading discrepancies occur when spherical ray theory is used with parameters determined from flat Earth formulae. Suggestions are made for corrections. Other geophysical techniques, using refraction data as a base, can accordingly be in error.—*from* Author's abstract

Merifield, P. M. *See* Lamar, D. L. 06006

06122 **Mering, J.; Brindley, G. W.** X-ray diffraction band profiles of montmorillonite—Influence of hydration and of the exchangeable cations, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 51–60, illus., 1967.

Previous studies of diffraction band profiles of montmorillonite are extended to the 13, 20 band which, for reasons discussed, is more sensitive to structural details than the diffraction bands considered previously. Hydration of Na-montmorillonite produces appreciable sharpening of this band, indicating, contrary to previous results, that the water layers have at least a partially ordered arrangement. For Cs-montmorillonite, the single water layer hydrate shows only a small sharpening of the band profile, possibly attributable to the water layer, but which clearly indicates that the Cs ions cannot be significantly displaced from their positions in the anhydrous material. For Ba-montmorillonite, the two layer hydrate shows a small broadening of the diffraction band, which is possibly the result of a partial ordering of the water layers together with a movement of the Ba ions away from the hexagonal holes.—Authors' abstract

06007 **Merriam, Daniel F.** Geologic use of the computer, *in* Symposium on recently developed geologic principles and sedimentation of the Permo-Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf., Casper, 1966: Casper, Wyo., Petroleum Inf., p. 109–112, illus. [1967?].

Uses of the computer in treating geologic data can be grouped into two categories: data processing and problem solving. Different applications discussed are: (1) Keyword-In-Context indexes, (2) trend surfaces, (3) Fourier series, (4) time series analysis, (5) cross-association, and (6) factor analysis.—KAS

Mesolella, Kenneth J. *See* Broecker, Wallace S. 00211

06016 **Middleton, Gerard V.** Experimental and field studies on the genesis of sandstones, *in* Symposium on recently developed geologic principles and sedimentation of the Permo–Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf., Casper, 1966: Casper, Wyo., Petroleum Inf., p. 23–29c, illus. [1967?].

Two of the advantages of experimental laboratory studies of sediment transport and deposition are: (1) a small part of the problem may be isolated and studied under controlled conditions; (2) it is possible to study the processes directly. Scaling problems can be considered by using dimensional analysis. Of the important dimensionless variables (Froude number, Reynolds number and the boundary Reynolds number) which should be identical in the model and in nature, only the Froude number can be properly scaled in the laboratory. It is thus impossible to produce laboratory models of large scale natural sedimentation phenomena which are proper scale models. The author's experiments on the formation of graded bedding by turbidity currents are used as an illustration.—KAS

Mido, Kiyoshi W. *See* Chun, Robert Y. D. 06106

06015 **Miller, D. N., Jr.** Diagenesis of sedimentary rocks, *in* Symposium on recently developed geologic principles and sedimentation of the Permo–Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf., Casper, 1966: Casper, Wyo., Petroleum Inf., p. 17–21k, illus. [1967?].

The following diagenetic principles are discussed in relation to their effect upon the porosity and permeability of sedimentary rock: dessication, cementation, preconsolidation slump, fracturing, jointing, weathering, and near surface or subsurface solution. Application of diagenetic principles to petroleum exploration is illustrated by six types of structural conditions from the Williston basin that can be defined on the basis of the vertical and horizontal distribution of diagenetic alteration.—KAS

Mink, J. F. *See* Lau, L. S. 06114

06157 **Mirtskhulava, Ts. E.; Dolidze, I. V.; Magomedova, A. V.** Mechanism and computation of local and general scour in non-cohesive, cohesive soils and rock beds [with French abs.], Paper C20 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 3: Fort Collins, Colo., Colorado State Univ., p. 169–176, table; discussion, ibid., V. 5, p. 467–468, 1967.

On the basis of theoretical, laboratory and natural investigations as well as on the established analogy between the destruction of cohesive soils due to "fatigue" and that due to the influence of turbulent flow in channel, a solution is given of general and local scour problems by a freely falling stream. The problems are: intensity of scour in relation to parameters of flow and soil properties, and prognosis of time necessary for the given soil scour and for the scour stabilization. A solution to prognosis of the size of erosion in heterogeneous, non cohesive soils has been established with due account of the natural paving of the bed and the granulometric composition curve. A comparison of the design data with data of laboratory and natural investigations shows quite satisfactory coincidence.—*from* Authors' abstract

05988 **Momper, James A.** Stratigraphic principles applied to the study of the Permian and Pennsylvanian systems in the Denver Basin, *in* Symposium on recently developed geologic principles and sedimentation of the Permo–Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf. 1966: Casper, Wyo., Petroleum Inf., p. 87–89, 90a–90r, illus. [1967?].

Some of the conclusions drawn after applying stratigraphic principles to the Denver Basin are as follows: (1) deposition in shelf areas during Permian and Pennsylvanian was not essentially continuous, (2) time represented by rocks on higher parts of the shelf is only a small part of the total time interval of the periods, (3) lacunas and consequent erosional surfaces resulting from cyclicity are often overlooked, (4) unconformities decrease in number both landward and seaward from a site on the shelf that is the location of more ideal cyclothem development and preservation,

(5) lacunas increase in magnitude landward and decrease seaward, (6) cyclothems and unconformities tend to hide one another, and (7) cyclothems are the result of eustasy and shelf subsidence caused by oceanic diastrophism.—KAS

00173 **Mook, W. G.; Vogel, J. C.** Isotopic equilibrium between shells and their environment: Science, v. 159, no. 3817, p. 874–875, illus., 1968.

The carbon isotopic composition of shell carbonate is shown to be in isotopic equilibrium with bicarbonate dissolved in the water. By measurement of both C-13 and O-18 in a series of brackish water shells a mean growth temperature can be deduced.—Authors' abstract

Moore, C. B. *See* Linn, T. A., Jr. 00205

Moore, Donald B. *See* Joiner, Thomas J. 06376

Moore, H. J., 3d. *See* Hinrichs, E. N. 00333

06455 **Moore, Peter Gerald.** The use of geological models in prospecting for stratigraphic traps [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 481–485, illus., 1967.

The use of geological models in finding stratigraphic traps is illustrated by means of a schematic diagram. Prototypes of geological phenomena from the real world are idealized into analogs and further generalized into templates. These templates are used to guide the construction of a predictive model of an exploration prospect. The results of test holes are fed back to modify the model or even in extreme cases to cause a new template to be selected. One must be careful not to use analogs too literally; this inserts unwarranted detail into the predictive model. And, in many cases, where the porosity and permeability are of secondary origin, it is better to construct a direct descriptive model of these properties than to infer them indirectly from an interpretative model of the primary facies.—Author's abstract

Moorhouse, Douglas C. *See* Greer, David M. 00210

Morris, D. A. *See* Johnson, A. I. 00312

Morrow, R. M. *See* Osment, F. C. 06404

Mortland, M. M. *See* Dowdy, R. H. 00344

Mortland, M. M. *See* Dowdy, R. H. 06196

Morton, D. M. *See* Baird, A. K. 06389

Morton, Robert W. *See* Pilkey, Orrin H. 06373

06187 **Mossman, M. H.; Freas, D. H.; Bailey, S. W.** Orienting internal standard method for clay mineral X-ray analysis, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 441–453, illus., 1967.

Use of a platy internal standard that will orient to the same degree as clay minerals preserves the relative diffraction intensities between basal reflections from platy components, regardless of degree of orientation. The method is illustrated with basic zinc chloride and pyrophyllite as internal standards for quantitative clay mineral analysis in the systems kaolinite—1 Md illite and $2M_1$ muscovite—montmorillonite. Illite does not orient to the same degree as kaolinite at high illite concentrations. In such nonlinear systems empirical working curves are more reliable than fixed ratios of the scattering powers of clay minerals present. The major error in application of this quantitative method arises from uncertainty as to the correct allocation of peak areas in cases of overlap of the mixed layer peak with those of discrete 10 A and 14 A clays also present.—*from* Authors' abstract

Moston, R. P. *See* Johnson, A. I. 00312

06440 **Mourant, Walter A.** Pecos River basin—Geography, geology, and hydrology, *in* Water resources of New Mexico (New Mexico State Engineer Office, compiler): Santa Fe, N. Mex., State Plan. Office, p. 60–73, illus., tables, 1967.

This basin comprises deeply dissected mountains and rolling hills in the headwaters region of Pecos River in the Sangre de Cristo uplift, and level and rolling plains toward the Texas border. Underlying rocks, mostly sedimentary, vary in age from Precambrian to Recent, with numerous Tertiary igneous intrusions in the western part. Various mineral resources include the world's largest potash operation east of Carlsbad. A generalized stratigraphic section giving unit thicknesses, distribution and properties, designates the aquifers which are chiefly unconsolidated sand and gravel, and limestone and sandstone; yields of over 300 gpm come from alluvium, generally stream connected, or from limestone. Little is known about the ground water at depth.—GDC

00336 **Mudge, Melville R.** Bedrock geologic map of the Castle Reef quadrangle, Teton and Lewis and Clark Counties, Montana: U.S. Geol. Survey Geol. Quad. Map GQ–711, scale 1:24,000, sections, 1968.

06384 **Muehlberger, William R.** Geology of Chama quadrangle, New Mexico: New Mexico Bur. Mines and Mineral Resources Bull. 89, 114 p., illus., table, geol. map, 1967.

The quadrangle is covered primarily by Mesozoic rocks, largely Cretaceous, with the Precambrian Kiawa Mtn. Formation outcropping along the east margin, and some Tertiary along the mountains. Only the Conejo Quartz Latite of the Tertiary volcanic sequence extends into the quadrangle. Quaternary deposits include three major sequences of terraces, moraines, landslides, and alluvium. Formations are described and Appendix A gives 12 measured sections; sedimentary petrography of three of these is given in Appendix B. Northwest trending folds and faults superimposed on a larger structural terrace, the Chama basin, dominate the quadrangle. The Brazos fault zone and Willow Creek and Horse Lake anticlines are described. Structure contour and geologic maps accompany the report.—ESL

06394 **Mueller, G.** Carbonaceous meteorites and the origin of life, *in* The origin of life, by J. D. Bernal, App. 2: Cleveland, Ohio, and New York World Publishing Co., p. 255–279, illus., 1967.

History of the controversy on the nature of the carbonaceous content of meteorites is reviewed. In the classification of carbonaceous chondrites, their properties are divided into: isotopic ratios of C, S, O, N, and H, elemental composition, trace elements within the carbonaceous complex, molecular composition, optical rotation, biogenic molecules, microstructure interpretation, indications of such complexes in cosmic dust, and cosmological indicators. The theoretical conclusion is reached that carbonaceous meteorites originate from asteroid type parent bodies, which would not permit the evolution of any life as we know it.—ESL

00206 **Munk, Miner N.** Argon, krypton, and xenon in Angra Dos Reis, Nuevo Laredo, and Norton County achondrites—The case for two types of fission xenon in achondrites: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 457–465, illus., tables, 1967 [1968].

Cosmic ray exposure ages of 68 m.y. and 16 m.y. for Angra Dos Reis and Nuevo Laredo are obtained. Calculations show that each has a fission xenon anomaly in that there is more than one type of fission xenon in these Ca-rich achondrites. Calculations show the linear spread in these two, and also in other untested, but reported Ca rich achondrites. The excess xenon could come from spontaneous fission of U-238 or from the carbonaceous chondrite type fission xenon reported by Pepin. U-238 fission is insufficient by factors of 34 and 18. Also, calculations show that U-235 in Stannern, a standard reference meteorite, could not be a major source of fission xenon.—*from* Author's abstract

06014 **Murray, Raymond C.** Carbonate sedimentation and diagenesis, *in* Symposium on recently developed geologic principles and sedimentation of the Permo-Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf., Casper, 1966: Casper, Wyo., Petroleum Inf., p. 16a–16h, illus., p. 12, 15 [1967?].

The author discusses the ideas advanced in recent carbonate and evaporite literature which are helpful in determining porosity history and the geology used to predict porosity histories. In predicting interparticle porosity in carbonate rocks, it is necessary to decide if the body is the product of current transport or competitive sedimentation before any depositional model is chosen. There is little evidence of precipitation of cement to lithify sediments in a marine environment. When rocks are exposed to fresh waters, they undergo coarse dissolution and much of the cement is produced in the zone of partial water saturation. Formation of nodular anhydrites is discussed. Dolomitization is one of the most significant processes that make potential reservoir rocks.—KAS

Murray, Raymond C. *See* Lucia, F. Jerry, 06437

Murthy, V. Rama. *See* Griffin, W. L. 00316

06287 **Musgrave, A. W.; Woolley, W. C.; Gray, Helen.** Outlining of salt and shale masses by refraction methods, *in* Seismic refraction prospecting (A. W. Musgrave, editor): Tulsa, Okla., Soc. Explor. Geophysicists, p. 426–458, illus., tables, 1967.

Surface-to-surface refraction lines define the top of a shallow domal mass previously located by reflection methods. A normal line off the flank is needed for comparison. If salt is identified, a map is made from the results of a number of refraction lines radiating from the center of the dome. The increased accuracy of this system is primarily dependent upon the accurate determination of velocities and distances. Flank wells are used for further refraction shooting which yield more accurate velocity information and more detailed profiles of the domal mass. A map from this integrated information permits exploitation at a minimum risk, even though every location is essentially a wildcat.—Authors' abstract

06277 **Musgrave, Albert W.** (editor). Seismic refraction prospecting: Tulsa, Okla., Soc. Explor. Geophysicists, 604 p., illus., tables, 1967.

This collection of 29 papers on the seismic refraction method of surveying describes, primarily, various techniques for separating out special raypath solutions and making approximations that give a structural geologic picture from a study of these approximations or specializations. The correct determination of distance, velocity, and time is of extreme importance in refraction surveying; each of these elements is discussed briefly in the introduction. Papers are grouped in eight sections: history of early refraction work, refraction models, amplitude of refraction signal, determination of weathering or LVL thickness, interpretation techniques, graphs and nomographs for interpretation, field techniques for shooting, case histories, and bibliographies. Four papers are cited individually.—VSN

06044 **Naldrett, A. J.; Kullerud, G.** A study of the Strathcona mine and its bearing on the origin of the nickel copper ores of the Sudbury district, Ontario: Jour. Petrology, v. 8, no. 3, p. 453–531, illus., tables, 1967.

At the base of the Nickel Irruptive along the north rim of the Sudbury basin are two augite norite intrusions (mafic and xenolithic), younger than the felsic norite of the Irruptive. The xenolithic norite grades downward into a hanging-wall breccia with even more xenoliths. In the matrix of this breccia the sulfides are disseminated, nickel content increasing systematically from 3 to 5.5 percent between there and the footwall; copper content is similar but more erratic. Contrasting percentages of pyrrhotite and pentlandite, textural relations between sulfides and silicates, and pyroxene indicative of high temperatures suggest that the hanging wall sulfides at Strathcona were introduced with the younger noritic intrusions; the ore at the base subsequently was incorporated into the brecciation which included some of the footwall gneiss.—GDC

Neuman, Robert B. *See* King, Philip B. 00263

New Mexico Interstate Stream Comm. *See* New Mexico State Engineer Office. 06442

06442 **New Mexico State Engineer Office; New Mexico Interstate Stream Comm.; U.S. Geological Survey.** Water resources of New Mexico—Occurrence, development, and use: Santa Fe, N. Mex., State Plan. Office, 321 p., illus., tables, 1967.

New Mexico's nine major drainage areas contribute to three continental river systems: the Lower Mississippi and Colorado Rivers and the Rio Grande. The hydrogeology, including chemical quality of water, is reported by individual authors (separately cited) for each of the nine divisions: Arkansas River basin, Southern High Plains, Pecos River basin, Central closed basins, Rio Grande basin, Western closed basins, San Juan River basin, Lower Colorado River basin, and Southwestern closed basins. Water development problems for urban rural-domestic, and industrial uses are considered for each division by authors not separately cited. Data is summarized by maps, graphs, and tables in the appendix.—GDC

06060 **Nichols, Harvey.** The suitability of certain categories of lake sediments for pollen analysis [with French abs.]: Pollen et Spores, v. 9, no. 3, p. 615–620, 1967.

It is suggested that certain types of lakes are potentially subject to sediment contamination and disturbance of the fossil pollen record; these are: lakes with rich bottom faunas; lakes with sub-lacustrine gullies; lakes subject to earthquakes; shallow lakes at high latitudes or high altitudes whose sediments are or have been liable to freezing; lakes used by cattle; lakes subject to changes of level; and lakes with a history of floating islands of organic matter.—Author's abstract

06381 **Nielsen, Eigil.** New observations on the skull-roof of the holotype of *Tupilakosaurus heilmani* Nielsen: Linnean Soc. London Jour., Zoology, v. 47, no. 311, p. 225–229, illus., 1967.

A restudy of the holotype of *Tupilakosaurus heilmani*, from Fish-zone V in the Eotriassic beds west of River VII near Kap Stosch, Northeast Greenland, after further preparation of the skull, showed that the original interpretation of the skull-roof was completely wrong. It now appears closely related to the Brachyopidae. Both *T. heilmani* and *T. wetlugensis* are embolomerous forms; it is probable that *Brachyops* was also.—GSA Bib. Staff

06128 **Nielsen, H. A.** Methods of natural science—An introduction: Englewood Cliffs, N. J., Prentice-Hall, 70 p., 1967.

This volume of the Prentice-Hall *Fundamentals of logic series* deals with methods of inquiry used in natural science, growing from investigative processes of thought used in the most ordinary domestic forms of inquiry. Where reference is made to actual sciences, the book is concerned only with the more accessible reaches, and with methods revealed in day-to-day research rather than in published results. Chapter headings are: basic types of reasoning; the logic of explanations; laws and general theories; other emphases in methodology; and the nature and limits of scientific truth.—ESL

Nielsen, Kenneth F. *See* Bisal, Frederick. 06176

06282 **Nielsen, R. L.** Origin of primary textural and mineralogical zoning in a copper-bearing quartz monzonite stock, Santa Rita, New Mexico [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B227–B228, 1967.

06166 **Nordin, Carl F.; Richardson, Everett V.** The use of stochastic models in studies of alluvial channel processes [with French abs.], Paper B11 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 2: Fort Collins, Colo., Colorado State Univ., p. 96–102, illus.; discussion, ibid., V. 5, p. 256–260, 1967.

Stochastic models can be used to describe either certain details of sediment transport phenomena or more general aspects of river channel morphology. The compound

Poisson process and the random walk serve as models for the dispersion of sediment particles, and a linear second-order Markov process gives the essential statistical properties of the profile of a dune-covered bed. Branching processes and the theory of most frequent random walks find application as models for river networks and river meandering. For simple cases, models describing transport phenomena could be combined with the models of channel morphology to produce a more complete picture of alluvial channel processes.—Authors' abstract

00293 **Norman, Jack C.; Haskin, Larry A.** The geochemistry of Sc—A comparison to the rare earths and Fe: Geochim. et Cosmochim. Acta, v. 32, no. 1, p. 93-108, illus., tables, 1968.

Results of neutron activation analyses ϕ for Sc and Fe in 76 samples of igneous and sedimentary rock, including 9 composites, are reported. The highest Sc contents (average, 30-40 ppm) were found in basalts and gabbros and the lowest in nepheline syenites and limestones (about 1 ppm). No evidence for the close geochemical relationship which might be expected between Sc and the heaviest rare earths on the basis of ionic size, charge, electronegativity, etc. was found. The presently available evidence does not support predictions for a close geochemical relationship between Sc^{+3} and Fe^{+2}, Mg^{+2}, or any other major element or ion in igneous rocks. A possible coherence between Sc and Fe in sedimentary rocks was found.—Authors' abstract

06034 **Norris, G.** Spores and pollen from the lower Colorado Group (Albian-?Cenomanian) of central Alberta: Palaeontographica, ser. B, v. 120, nos. 1-4, p. 72-115, illus., 1967.

Miospore assemblages characteristic of the Joli Fou and Viking formations and an upper shale unit are described from a core obtained in central Alberta. Stratigraphically significant species in the Grand Rapids Formation (upper part of the Manville Group) and lower Colorado beds are selected and their value discussed. A sharp break at the Manville-Colorado contact confirms a regional unconformity. The Joli Fou correlates with the Blairmore elsewhere. Most of the units are Albian; the upper beds may be Cenomanian. The parent flora was primarily schizeaceous ferns, pines, podocarps, and angiosperms. The Manville flora is similar but contains more hepatic, cycad, ephedraleans, but no angiosperms. Eighty-nine species, seven new, are described.—*from* Author's summary

00273 **Nowroozi, A. A.** Measurements of Q values from the free oscillations of the Earth: Jour. Geophys. Research, v. 73, no. 4, p. 1407-1415, illus., tables, 1968.

The Q values for spheroidal and torsional oscillations of the Earth are estimated from time decay of spectral amplitudes for each mode, using data from the Alaskan earthquake of March 1964 and Aleutian earthquake of February 1965. Results indicate average Q values of 181 ± 18 for spheroidal first overtone modes and 251 ± 42 for spheroidal fundamental modes. The period range for spheroidal fundamental modes is 305-579 sec; constancy of Q values for this range indicates that the mantle high Q value starts at a depth greater than 600 km. Average Q for torsional modes is 194 ± 56.—DBV

Oda, Atsuko. *See* Hayatsu, Ryoichi, 00294

06079 **Odishaw, Hugh.** (editor). The Earth in space: New York and London, Basic Books, 340 p., 1967.

The thirty essays in this volume present current views as to the nature of the Earth, the solar system, and the galaxies stemming from a series of lectures prepared for the Voice of America. Papers are grouped in five parts: the solar system and the Sun, the Earth and the Moon, other planets and objects, the cosmic environment, and life. Eight papers are cited separately.—VSN

06041 **Oertel, G.; Walton, E. K.** Lessons from a feasibility study for computer models of coal-bearing deltas: Sedimentology, v. 9, no. 2, p. 157-168, illus., 1967.

A computer-generated model of a coal-bearing delta would be desirable if it included enough detail to reproduce the cyclical nature of the sediments. At the present stage of development of computers, and with the present state of knowledge of quantitative transportation and sedimentation, it is not yet possible to set up such a model. However, the logical arrangement in a flow-diagram of the processes and parameters involved in delta formation strongly suggests that cyclical sedimentation can occur without the need for an external cyclical cause, such as tectonic or climatic oscillations. Attempts to provide for checks of a computer model bring out overall regularities in the assemblages of cyclic types in three different coal basins.—*from* Authors' summary

00306 **Ogren, David E.** Stratigraphy of Upper Mississippian rocks of northern Arkansas: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 282–294, illus., 1968.

Recommendations are made for a revision of terminology and correlations in the Upper Mississippian strata of northern Arkansas. The terms "Mayes Group" and "Hindsville Formation" are applied as they are used in northeast Oklahoma, the term "Ruddell Shale" is recommended for abandonment, and the terms "Marcella Formation" and "Wallace Creek Shale Member" are proposed.—Author's abstract

Oliver, Robert M. *See* Jonas, Edward C. 06119

06162 **O'Loughlin, Emmett M.; Squarer, David.** Areal variations of bed-form characteristics in meandering streams [with French abs.], Paper B14 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 2: Fort Collins, Colo., Colorado State Univ., p. 118–127, illus.; discussion, ibid., V. 5, p. 251–252, 261–263, 1967.

The validity of laws derived from straight flume experiments is open to question when applied to sinuous channels, because no account may be taken of sectional distortion or secondary currents induced by boundary curvature. On a gross scale, quantitative patterns of erosion and deposition in bends should be expressed in terms of mean flow variables; selection of which to use is a problem relevant not only to flow in the bend itself but also to that through reaches between bends. Experimental bed form geometries in straight and meandering laboratory channels, with identical flow conditions and bed materials, were computed in terms of descriptors used by Norden and Algert (1966); autocovariance and spectral density as functions of distance along the channels are compared. Future analyses should be made in the time domain, possibly relating time and space spectra.—GDC

00374 **Olson, J. C.; Hedlund, D. C.; Hansen, W. R.** Tertiary volcanic stratigraphy in the Powderhorn-Black Canyon region, Gunnison and Montrose Counties, Colorado: U.S. Geol. Survey Bull. 1251-C, p. C1–C29, illus., table, geol. map, 1968.

Volcanic flows, breccia, conglomerate, and tuff were deposited during several episodes of Tertiary volcanic activity in the Powderhorn-Black Canyon region of Colorado. The oldest Tertiary volcanic rocks, the Lake Fork Formation and West Elk Breccia, were deposited during the same general episode and formed a composite mass of intermediate flows and breccias probably several thousand feet thick. Ash-flow tuffs were erupted explosively after extensive erosion of the Lake Fork and West Elk volcanic piles. The ash-flow tuff sequence is divided into five formations in the region and here named, from oldest to youngest: the Blue Mesa, Dillon Mesa, Sapinero Mesa, Fish Canyon, and Carpenter Ridge Tuffs. Biotite from the Fish Canyon Tuff has a KAr age of about 27 m.y. After the ash flows, dark flows of the Hinsdale Formation were erupted upon an erosional surface of low relief.—JCO

06290 **Oparin, A. I.** The origin of life (translated by Ann Synge), *in* The origin of life, by J. D. Bernal, App. 1: Cleveland, Ohio, and New York, World Publishing Co., p. 199–234, 1967; originally published in Russian, 1924.

The theories of spontaneous generation and panspermia are discussed as an introduction to the three main topics: the world of the living and the world of

the dead (mineral world), from uncombined elements to organic compounds, and from organic substance to the living thing. Several pages of comments by Bernal accompany the paper.—ESL

05983 **Opdyke, N. D.; Foster, J. H.** Reversals of the Earth's magnetic field: Sci. Jour., v. 3, no. 9, p. 56–61, illus., 1967.

Deep sea-bed cores show conclusively several reversals in direction of the Earth's magnetic field; the pattern is similar to that derived from lava flows. Early research and conflicting ideas are reviewed. The four main reversal epochs bear the names of famous workers: Gilbert, Gauss, Matuyama, and Brunhes. Rocks of the same K-Ar age from different parts of the world have the same polarity. Extinction of certain radiolaria has been questionably connected with magnetic reversals; greater intensity of radiation may have accelerated the process of evolution. Anomalies strikingly parallel to midoceanic ridges can be correlated with reversals from dated lava flows on land.—GDC

Orange, A. S. *See* Brace, W. F. 00279

06404 **Osment, F. C.; Morrow, R. M.; Craig, R. W.** Petroleum geology and development of the Cook Island Inlet basin of Alaska [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 141–150, illus., 1967.

Alaska's major oil and gas fields are located onshore and offshore 60 to 80 miles southwest of Anchorage in the Cook Inlet basin. The State's first major oil field, discovered onshore at Swanson River in 1957, has produced over 51 million bbl of oil. Alaska is now the seventeenth largest oil producing state in the United States. After the Swanson River discovery, exploration accelerated rapidly and moved into offshore areas where several major fields were discovered. It is conservatively estimated that ultimately the Cook Inlet basin will yield reserves of 1.5 billion bbl oil and 5 trillion cu ft gas. Production in the Cook Inlet basin is entirely from the nonmarine Tertiary Kenai Formation. Structures in the basin are complex; the largest accumulation of oil sands, totaling over 1,500 feet, is found in the Middle Ground Shoal field.—*from* Authors' abstract

00208 **Osmond, J. K.; Pollard, Lin D.** Sedimentation rate determination in deep sea cores by gamma-ray spectrometry: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 476–480, illus., 1967 [1968].

Non-destructive gamma ray spectrometric analysis of deep sea core samples provides a variation on the ionium excess method of sedimentation rate determination. It is based on the measurement of Bi 214, daughter of Th 230 and profiles of several cores indicate that a 300,000 year time line can be determined. These same profiles give evidence for considerable diffusion of radium near the top of the cores. Sedimentation rates determined by the gamma method agree in general with Th 230 radiometric analyses; however, comparison with sedimentation rates determined in the same cores by paleomagnetic polarity epochs suggests that the sedimentation rates for the last 300,000 years may have decreased somewhat.—Authors' abstract

00323 **Overstreet, William C.; White, Amos M.; Whitlow, Jesse W.; Theobald, Paul K., Jr.; Caldwell, Dabney W.; Cuppels, Norman P.** Fluvial monazite deposits in the southeastern United States, *with a section on* mineral analyses by Jerome Stone: U.S. Geol. Survey Prof. Paper 568, 85 p., illus., tables, 1968.

Reconnaissance investigation of fluviatile monazite placers was conducted at five places in the Inner Piedmont belt from Virginia through Georgia. The area between the Savannah and Catawba Rivers, South Carolina-North Carolina, contains more potential sources of monazite than other areas in the Inner Piedmont, but none is considered an economic source for monazite. Industrial minerals of potential use associated with the placer monazite are, with the possible exception of garnet, not abundant enough to affect a notable increase in the value of the heavy mineral concentrate. The field, laboratory, and office techniques developed in this

reconnaissance could be used in other areas of deeply weathered rocks overlain by residual soil.—Authors' abstract

Overton, A. *See* Hobson, George D. 06395

00272 **Ozima, M.; Kaneoka, I.** Reply [to G. B. Dalrymple and R. R. Doell's discussion of "Paleomagnetism and potassium–argon ages of some volcanic rocks from the Rio Grande gorge, New Mexico", 1967]: Jour. Geophys. Research, v. 73, no. 4, p. 1504–1505, table, 1968.

Ozima and Kaneoka agree with Dalrymple and Doell (ibid., p. 1502–1503) that the N–R boundary at 3.6–3.7 m.y. may correspond to another normal event within the Gilbert reversed epoch. Apropos of the confidence level of estimates of the time of polarity transition, they emphasize that the reliability of K–Ar ages depends very crucially on the choice of samples, and there is as yet no well established criterion for their choice on the basis of thin-section examination. This point is illustrated by the example of K–Ar determinations on basalts from a single successive lava flow in Kyushu, Japan, which are internally inconsistent. A most objective and substantial criterion for the reliability of K–Ar ages of young eruptive rocks would be one based on internal consistencies within and among flows.—DBV

00345 **Page, Virginia M.** Angiosperm wood from the Upper Cretaceous of central California, Pt. 2: Am. Jour. Botany, v. 55, no. 2, p. 168–172, illus., 1968.

Three species of fossil wood representing two genera are described. The specimens are from a collection of woods from the Upper Cretaceous Panoche Formation of central California. *Tetracentronites panochetris* sp. nov. resembles angiosperm wood in ray structure and vascular pitting but lacks vessels. *Plataninium platanoides* sp. nov. is similar to the wood of *Platanus*, and the evidence presented points to a direct relationship. The resemblance between *Plataninium californicum* sp. nov. and the woods of certain Icacinaceae is discussed, but evidence of relationship is inconclusive.—Author's abstract

00305 **Paine, William R.** Stratigraphy and sedimentation of subsurface Hackberry wedge and associated beds of southwestern Louisiana: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 2, p. 322–342, illus., 1968.

The Hackberry wedge of the Oligocene(?) Frio Formation can be divided into two parts. The upper part ranges in thickness from zero to more than 3,000 feet, consists mainly of shale, and contains an outer-neritic microfaunal assemblage. The lower part ranges in thickness from zero to 700 feet and consists essentially of sandstone. The sequence of events in the deposition of the Frio Formation of northern Jefferson Davis and Calcasieu Parishes is summarized as follows: 1) deposition of lower Frio *Textularia seligi* zone; 2) development of lower unconformity; 3) deposition of lower Frio and Hartburg sediments; 4) uplift, folding, erosion, and development of "pre Hackberry unconformity;" 5) tilting of the unconformity surface and channel forming erosion; 6) filling of the channels with basal Hackberry sandstones; 7) deposition of Hackberry shale; and 8) deposition of the remainder of the Frio.—EAM

00264 **Palmer, Allison R.** Cambrian trilobites of east-central Alaska: U.S. Geol. Survey Prof. Paper 559-B, p. B1–B115, illus., 1968.

A total of 127 trilobite species is represented in 3 Early Cambrian, 2 late Middle Cambrian, and 6 Late Cambrian faunas. The Late Cambrian faunas are divided equally among the Dresbachian, Franconian, and Trempeleauan stages. Strong Asiatic affinities are indicated in the six faunas representing Early to Late Cambrian ages. Strong affinities to faunas of eastern North America are also indicated.—ARP

00194 **Papadopoulos, George T.; Laguros, Joakim G.** Programming for Pavlovsky's ground water problem: Am. Soc. Civil Engineers Proc., v. 94, paper 5840, Jour. Irrigation and Drainage Div., no. IR 1, p. 49–56, illus., 1968.

The amount of seepage and the free surface profile in an unconfined flow between two water bodies above an inclined impervious layer are highly dependent on the

normal depth of flow. Pavlovsky's solution requires a rather time-consuming graphical method of calculating the value of the normal depth. The computer program presented herein not only reduces the time element but it also encompasses the rising surface and falling surface types of flow for values of slope greater and less than zero and for a range of headwater and tailwater values. This is made possible by using Kuo's method of false position, which is uniquely adapted to problems where the unknown function is expressed unavoidably in terms of the same unknown parameter. Variations in the length of the impervious medium are considered and one example is presented.—Authors' abstract

Papike, J. J. *See* Ross, Malcolm. 00177

Papike, J. J. *See* Burnham, Charles W. 05991

06150 **Park, Yong Ahn.** Petrography and depositional environments of the Triassic border conglomerates in New Jersey: Geol. Soc. Korea Jour., v. 3, no. 1, p. 36-50, illus., 1967.

This paper discusses the origin and depositional environments of the Triassic border conglomerates in New Jersey. These border conglomerates are more properly called fanglomerates. Sources for the gravels were principally the Silurian Green Pond and Decker Formations, the Cambro-Ordovician Kittatiny Formation, and Precambrian crystalline rocks.—*from* Author's abstract

06030 **Parker, Mary Combs.** La Porte City Chert—A Devonian subsurface formation in central Iowa: Iowa Geol. Survey Rept. Inv. 4, 12 p., illus., 1967.

A study of well samples from central Iowa shows that a distinct rock stratigraphic unit is present beneath the Devonian Wapsipinicon Formation and above the characteristic dolomites and cherts of the Silurian Niagaran Series. This subsurface unit consists primarily of medium- to dark gray chert and light gray limestone. The unit has been traced into southwestern Iowa and its boundaries have been fairly well defined. The name La Porte City Chert, derived from the town of La Porte City in southeastern Blackhawk County, is proposed for this formation. The lithologic characteristics and distribution of the La Porte City Chert in Iowa are shown by graphic well sections and a thickness map.—Author's abstract

00176 **Parkin, David W.; Tilles, David.** Influx measurements of extraterrestrial material: Science, v. 159, no. 3818, p. 936-946, illus., table, 1968.

The types of extraterrestrial material falling on the Earth and ways of detecting and measuring them are reviewed. The measurements appear to be converging on 10^{2} to 10^{3} tons per day total current influx, with only Antarctic nickel measurements suggesting significantly higher values. The nature of most of this material is unknown, but it is desirable to search for carbonaceous material (there is some indication of its possible presence in polar snow). No fine-grained material other than the high-nickel metal-cored deep-sea spherules has even now been completely and unambiguously determined as extraterrestrial in the presence of ubiquitous terrestrial contamination; the challenge of identifying and describing this material is as urgent as, and more uncertain than, the question of total influx rate.—DBV

Patton, John B. *See* Becker, Leroy E. 00310

Paul, E. A. *See* Campbell, C. A. 06265

Peacor, Donald R. *See* Foit, Franklin F., Jr. 05992

00196 **Peckham, Richard C.** Role of ground water in Texas Water Plan: Am. Soc. Civil Engineers Proc., v. 94, paper 5874, Jour. Irrigation and Drainage Div., no. IR 1, p. 137-152, illus., tables, 1968.

The Texas Water Plan has given extensive attention to the availability of ground water in aquifers of the State. By the year 2020, approximately 5,400,000 acre-ft of ground water will be used in meeting the State's water requirements. There are approximately 5,000,000 acre-ft available annually from the major and minor

aquifers of the State and approximately 365,000,00 acre ft available from storage in aquifers which receive little or no recharge.—Author's abstract

06112 **Pecuil, T. E.; Wampler, J. M.; Weaver, C. E.** A study of iron in clay minerals using Mössbauer spectroscopy [abs.], *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 143–144, table, 1967.

06056 **Penner, E.** Heaving pressure in soils during unidirectional freezing [with French abs.]: Canadian Geotech. Jour., v. 4, no. 4, p. 398–408, illus., table, 1967.

Ice lenses in natural soil are normally formed in a thermal gradient regime, and this permits the development of an undulating frost line if a range of pore sizes exists. Evidence is presented that suggests that the undulating nature of the ice–water interface permits the ice lens to form over the smaller pores of the system. Although fractions with only a limited particle size range have been studied, the results support the use of particle size as a valid basis for assessing frost susceptibility.—Author's abstract

06253 **Perkins, T. K.** Application of rock mechanics in hydraulic fracturing theories [with French abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 75–84, illus., tables, 1967.

Three aspects of rock mechanics have been of great value in developing hydraulic fracturing theories, viz.: (1) elastic behavior, (2) shear failure criteria, (3) concepts of fracture propagation. Within the framework of these concepts, the following topics will be discussed: (1) the relationship between rock matrix stress and total stress, (2) estimates and significance of in situ earth stresses, (3) factors influencing fracture orientation, (4) fracture extension pressures, (5) apparent rock surface energies, (6) fracture widths.—Author's abstract

Peters, Helen J. *See* Johnson, Thelma A. 06113

00301 **Peters, John C.; Bowler, Russell A.** River-bed degradation below dams—Discussion [of paper 5335 by S. Komura and D. B. Simons, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 5825, Jour. Hydraulics Div., no. HY2, p. 590–593, illus., 1968.

The writers have applied the Tinney approach to the problem discussed in paper 5335 [ibid., v. 93, no. HY4, p. 1–14, 1967], using many sediment transport formulas in a computer program. It is suggested that incorporation of various sediment transport formulas in the method proposed by the authors is certainly worthwhile in any future verification.—ESL

05987 **Peterson, James A.** Genesis and diagenesis of Paradox basin carbonate mound reservoirs, *in* Symposium on recently developed geologic principles and sedimentation of the Permo Pennsylvanian of the Rocky Mountains—Wyoming Geol. Assoc., 20th Ann. Conf., Casper, 1966: Casper, Wyo., Petroleum Inf., p. 67–86*l*, illus. [1967?].

Shelf carbonate mound bearing facies characteristic of the southwest basin flank probably formed as a consequence of gentle basin shelf topography during rising sea level or transgressive phase of each major Des Moines deposition cycle. Discussion of genesis of major carbonate mounds, which occur in the upper cycles (Desert Creek and Ismay) of the Paradox Formation, depicts the following sequence of events in growth of the mound belts: deposition of black sapropelic shale and silt with rising sea level; carbonate mudbank development on top of black mud; algal mound growth with maximum rise of sea level; foraminiferal pellet lime mud with early falling sea level; evaporite deposition, mounds emergent, and diagenesis in form of leaching, recrystallization and dolomitization. Regional Pennsylvanian and Permian facies relations are discussed.—KAS

06099 **Philpotts, A. R.** Belleau Desaulniers area, Saint Maurice, Maskinongé and Laviolette Counties [also French edition]: Quebec Dept. Nat. Resources Geol. Rept. 127, 51 p., illus., tables, geol. map, 1967.

In this area jointed Precambrian metamorphic and igneous rocks are moderately deformed, with open folds in a SE plunging syncline. Well exposed in the northern half, the Grenville Series is 16,000 feet thick; lithologic sequences and composition are reviewed. The younger Morin Series, extensive in the south, is dealt with in more detail: early anorthosite, norites, and mangerites in a concordant body 7,000 feet thick, intrude the upper Grenville paragneisses, contrasting with later discordant quartz monzonite and granite; black pseudotachylites occur as aphanitic matrix and glassy veins in the breccia zone of a major NE trending fault. Chemical analyses of Grenville amphibolites and various Morin rocks are tabulated. Sulfide mineralization in anorthosite and norite east of Larose Lake may be potential ore. Uraninite occurs in many pegmatites; the coarse quartz monzonite would make good building stone.—GDC

Phinney, W. C. *See* Griffin, W. L. 00316

Phinney, William C. *See* Himmelberg, G. R. 06042

06254 **Phizackerley, P. H.; Scott, L. O.** Major tar sand deposits of the world [with French and Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 551–571, illus., 1967.

The term "tar sand" is discussed and the distribution of both major and minor deposits of the world shown. Details of the stratigraphy, lithology, facies and structure of twenty major tar accumulations in Canada, Venezuela, Malagasy, U.S.A., Albania, Trinidad, Rumania and the U.S.S.R. are given together with reserve figures where known. The relationships of tar oil impregnation to the geological setting and presumed origin of the oil are discussed. The paper concludes with a brief résumé of other world occurrences and the present state of commercial development of tar sands.—Authors' abstract

Pierce, Paul W., 3d. *See* Anding, Malcolm G. 06163

06373 **Pilkey, Orrin H.; Morton, Robert W.; Luternauer, John.** The carbonate fraction of beach and dune sands: Sedimentology, v. 8, no. 4, p. 311–327, illus., tables, 1967.

The sand of the southeastern U.S. Atlantic coast was investigated from the standpoint of mineralogy, roundness, and size distribution. Carbonate ranges in abundance from 1 to over 40 percent and averages about 10 percent; it is least abundant in Georgia beaches and increases slightly to the north and greatly to the south. The size distribution of the carbonate fraction is similar to that of the noncarbonate fraction. The variable shape of the fragments causes the carbonate to be usually coarser and more poorly sorted than the acid insoluble fraction. There is almost a total absence of high Mg calcite. Aragonite is the dominant mineral.—*from* Authors' abstract

06155 **Pirkovský, M.; Rohan, K.** On the problem of longitudinal profile stabilization in streams transporting sediment [with French abs.], Paper C28 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 3: Fort Collins, Colo., Colorado State Univ., p. 237–248, illus.; discussion, ibid., V. 5, p. 479–480, 484, 1967.

A stabilized sediment transporting stream is characterized by a longitudinal profile, nearly the shape of a curve, the slope of which continually decreases downstream. The characteristic change of the bedload grains along the length of the stream is given by the law of their abrasion. By combining the law pertaining to the bedload discharge with that of grain abrasion, it is possible to obtain hypothetical conditions for the stabilization of a stream. The Meyer-Peter equation belongs to the tested regularities for the bedload discharge, and the equation of Schaffernak can be considered suitable for the regularity of the abrasion. The slope curve for portions of the Danube River is an example.—GDC

Poag, C. W. *See* Seiglie, George A. 00337

06436 **Polasek, Theo L.; Hutchinson, C. A., Jr.** Characterization of non-uniformities within a sandstone reservoir from a fluid mechanics standpoint [with French abs.], *in* Origin of oil, geology and geophysics—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 2: London, Elsevier Publishing Co., p. 397-407, illus., 1967.

Reservoir engineers usually model nonuniformity of permeability within the sandy part of a continuous reservoir to predict reservoir performance. This model will be inadequate whenever the spatial arrangement of the shales, sandy shales, and sands within the reservoir is more important to fluid movement. This paper presents the conclusions from three years of outcrop study to determine the permeability variation in sandstones. An approach for describing the spatial arrangements of sands and shaly sands in a reservoir and to take this arrangement into account in reservoir performance projections is proposed. An empirical heterogeneity factor relationship has been developed.—Authors' abstract

Poldervaart, Arie. *See* Hess, H. H. 06245

Pollard, Lin D. *See* Osmond, J. K. 00208

06425 **Pomerol, Charles.** Comparative study of deviation index Hqa, Qdϕ, and S_o: Sedimentology, v. 8, no. 2, p. 153-157, illus., 1967.

The deviation index Hqa is studied by use of the A.F.N.O.R. set of sieves. The authors show the connection between Hqa and the sorting index (S_o) of Trask, and the connection between Hqa and the Qdϕ index of Krumbein. (Hqa = 3Qdϕ, approximately).—Author's summary

06052 **Porter, Stephen C.** Glaciation of the Chagvan Bay area, southwestern Alaska: Arctic, v. 20, no. 4, p. 227-246, illus., 1967.

Glaciers, originating from the Ahklun Mountains, covered the area as lobes from piedmont glaciers at least four times. The oldest drift came from Kemuk glaciation and is deeply weathered and completely covered by younger drift. The next glaciation, the Clara Creek, is shown by massive moraines which have been deeply eroded and much mass-wasted. Drift from the less extensive Chagvan and final Unaluk glaciations are less modified. Radiocarbon dates for the Chagvan glaciation are >45,000 years and for the Unaluk drift are 8,910±110 years. A bedrock channel, now covered, was cut when sea level was 200 feet lower. A late Tertiary submergence of the Bering Shelf is indicated, followed by eustatic changes resulting from Pleistocene glaciation.—*from* Author's abstract

Potter, Paul Edwin. *See* Scheidegger, Adrian E. 06429

Prewitt, C. T. *See* Burnham, Charles W. 05991

05995 **Prewitt, C. T.** Refinement of the structure of pectolite, $Ca_2NaHSi_3O_9$ [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 298-316, illus., tables, 1967.

Structure of a pectolite [from Bergen Hill, N.J.] has been refined by least squares using new counter diffractometer data. Evidence for hydrogen bonding between O(3) and O(4) is based on the refinement results and examination of infrared spectra. Variations in Si-O distances are discussed in terms of $d\pi$-$p\pi$ bonding between silicon and oxygen.—*from* Author's abstract

Price, P. B. *See* Fleischer, R. L. 00298

06038 **Prince, Paul A.** Environmental effects of permafrost: Pennsylvania Geographer, v. 5, no. 4, p. 4-10, illus., 1967.

Permafrost underlies 20 percent of the world's land area. It occurs when temperatures remain below 32° for a number of years, and it is suspected that it first appeared during the Pleistocene. Permafrost areas are divided into continuous and discontinuous zones; boundaries are still being refined. The frozen zone is

much thinner under deglaciated areas than under nonglaciated. Above permafrost areas is a surface layer that thaws and freezes. Age and origin of permafrost differ from one region to another; some features influencing it are described. Permafrost influences the chemistry of surface water, supports frost action, aids in solifluction and other mass movements, and affects geophysical measurements. Engineering problems include sensitivity to thermal changes, impermeability, and ice content.—ESL

06241 **Prinz, Martin.** Geochemistry of basaltic rocks—Trace elements, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 271–323, illus., tables, 1967.

Interlaboratory variation of the trace elements considered ranges from poor to good. The median value is probably a more accurate measure of trace element average values than the arithmetic mean. Ba(?), Li, Ni, Sc, and Zr have means significantly lower than generally accepted averages. Trace element distribution in basalts cannot be explained by any simple theory. Frequency distribution patterns and petrologic data provide a chemical definition of trace elements. Factor analysis shows no unique trace element basaltic rock because of gradations. Co and Ga show no variations in basaltic rocks. By trace elements, it is not possible to recognize alkalic or tholeiitic trends. Initial abundance variations are suggested for some trace elements. Factor analysis shows four end member rocks can be recognized.—*from* Author's conclusions

06325 **Pryor, Wayne A.** Biogenic directional features on several Recent point bars: Sed. Geology, v. 1, no. 3, p. 235–245, illus., tables, 1967.

Fresh-water pelecypods and gastropods are distributed on Recent point bars of the Wabash River in western Indiana and the Whitewater River in western Ohio with larger species and individuals at the upper, coarse sediment ends of bars and smaller species and individuals at the lower, fine sediment ends of bars. Molluscs trapped in back-bar slough areas during and after floods make random patterned trails and burrows; molluscs on the bar foreshore migrate down slope with the shoreline, leaving straight, long trails oriented at right angles to the shoreline. On the foreshore, burrows and articulated shells are oriented down slope toward the thalweg. These products of biogenic origin have a potential use as paleogeographic indicators of point-bar orientation and meander migration direction in ancient river sediments.—*from* Author's summary

06421 **Puminov, A. P.** Karta noveyshey tektoniki Arktiki: Akad. Nauk SSSR Doklady, v. 175, no. 4, p. 901–902, illus., 1967; translation, A chart of the recent tectonics of the Arctic: Canada Defence Research Board Directorate Sci. Inf. Services [Rept.] T 487 R, 8 p., illus., 1967.

A highly schematized reproduction is given here of a map of recent tectonics of the Arctic, compiled in 1966. On the basis of trends and intensity of recent tectonic movements, continental and oceanic platforms, orogenic regions, and geosynclinal regions are defined.—ESL

00189 **Pyke, D. R.** Langmuir Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 444, scale 1 in. to 1/4 mi., text, 1968.

In the southern part of the map area, metamorphosed, serpentinized olivine basalts are dominant; in the northwest, serpentinized ultramafic and mafic intrusive rocks form sill-like bodies within the volcanics; and minor, flat-lying conglomerate, graywacke and argillite of the Cobalt Group outcrop in the southwest corner. Diabase dikes cut all the above rock types. The main structural trend swings from a SW direction in the north to a more westerly direction in the central and southern portions. Major fault and shear zones appear to be generally in a N–NW direction. Among deposits of economic interest are barite, asbestos, nickel, and iron formation, but none seems to be of great importance.—MCM

00190 **Pyke, D. R.** Blackstock Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 445, scale 1 in. to 1/4 mi., text, 1968.

The majority of the outcrop in Blackstock Township is confined to the south portion and consists almost entirely of a medium- to coarse-grained granite which forms well-rounded outcrops, weathers to light shades of pink and grey, and generally possesses weak to moderate foliation. Locally the granite is highly fractured and contains numerous quartz veins. Intermittent outcroppings of diabase outline a NE-SW trending dike extending across most of the township. The abrupt termination of the northeast end of the diabase may be indicative of a N-S trending fault coincident with the Whitefish River. Volcanics, mainly mafic pyroclastics, form a few scattered outcrops around the township's perimeter. Because of the preponderance of granite, mineral exploration activity has been minor.—MCM

Radtke, A. S. *See* Roberts, R. J. 06397

06156 **Rahm, S. Lennart; Appelgren, Bo G.** A study on seepage surface erosion in noncohesive soils [with French abs.], Paper C21 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 3: Fort Collins, Colo., Colorado State Univ., p. 177–184, illus.; discussion, ibid., V. 5, p. 456–457, 1967.

Ground-water seepage around storage areas may cause considerable surface erosion on unprotected slopes in fine frictional soils, due to entrainment of individual grains at the seepage surface. The potential field close to the lower terminus of the seepage surface is discussed theoretically, and asymptotic solutions satisfying nonlinear boundary conditions are presented. A classical linear condition is reasonable, as the range of nonlinearity is small relative to the grain size. The results of tests carried out for various soils and slope inclinations show that the concept of a critical seepage surface extension offers a simply measurable property, applicable to slope section development at repeated level fluctuations.—*from* Authors' abstract

06169 **Rathbun, R. E.; Guy, H. P.** Effect of non-equilibrium flow conditions on sediment transport and bed roughness in a laboratory alluvial channel [with French abs.], Paper A23 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 187–193, illus.; discussion, ibid., V. 5, p. 77–79, 1967.

Non-equilibrium flow conditions were examined in a laboratory alluvial channel to determine responses of the recirculation and sand-feed systems of flume operation to changes in load, tailwater depth, and sand-bed slope. It was found that the simple proportionality suggested by Lane (1955) for relating sediment transport rate, sandize, water discharge and slope predicted qualitatively the results. Experiments were limited to one water discharge and one sand.—Authors' abstract

Read, William A. *See* Belt, Edward S. 06368

00359 **Reeburgh, William S.** Determination of gases in sediments: Environmental Sci. and Technology, v. 2, no. 2, p. 140–141, illus., table, 1968.

A method was developed for sampling and analysis of gases contained in interstitial water. Interstitial water was separated from sediments with a filter press-type sediment squeezer and transferred to a specially designed sampler-stripper. Gases contained in the interstitial water were stripped from solution and analyzed by gas chromatography. Argon, N_2, and CH_4 have been measured in sediments. The technique can be used to measure total CO_2 and H_2S with minor modifications.—Author's abstract

06203 **Regis, A. J.; Sand, L. B.** Lateral gradation of chabazite to herschelite in the San Simon basin [abs.], *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 193, 1967.

00259 **Reider, Richard G.** Some geographic themes in the prehistory of the Great Plains: Pennsylvania Geographer, v. 6, no. 1, p. 6–10, 1968.

The crustal disturbance that raised the Rocky Mts. formed a deep trough on the east, bordered by a broad arch dipping eastward. Erosion blanketed the plains with massive fans extending hundreds of miles. Gullies and terraces formed and

the northern part was covered with glacial till, with outwash plains and wind deposits over a much greater area. Soil formation indicates an interglacial climate similar to that of today. The inorganic–organic association has been building for millenia; grasslands are a product of Tertiary and interglacial dominant dry climate. The date of man's first appearance on the plains is not known but Minnesota Man is about 20,000 yr old, and C–14 dates of artifacts give about 25,000 yr. No skeletal remains of Folsom Man, 7,000 to 10,000 B.P., have been found; shortly after this time the hunters and the mammals they hunted disappeared from the plains.—ESL

Rennie, D. A. *See* Campbell, C. A. 06265

Reynolds, P. H. *See* Russell, R. D. 00372

Ribbe, P. H. *See* Corlett, M. 06029

00335 **Rice, Charles L.** Geologic map of the Redbush quadrangle, eastern Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–708, scale 1:24,000, section, text, 1968.

Oil and gas, principal developed resources of the Redbush quadrangle, have been produced commercially since about 1917. Oil pools are reportedly found in stratigraphic traps in the Lower Mississippian "Weir" sandstone; gas is produced from the "Weir", Berea Sandstone, Ohio Shale, "Corniferous" dolomite, and "Big Six" sandstone. Coal beds are generally thin or irregular in thickness; where as thick as 24 in., they have been mined for local use. Underclay of coal beds is generally too thin to be of commercial value, but some shale of the Breathitt Formation is suitable for lightweight aggregates, brick, and some ceramics. Some sandstone has been quarried.—MCM

Richardson, Everett V. *See* Nordin, Carl F. 06166

Richardson, Everett V. *See* Chang, Feng–Ming. 06167

06168 **Richardson, Everett V.; Simons, Daryl B.** Resistance to flow in sand channels [with French abs.], Paper A18 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 141–150, illus.; discussion and reply, ibid., V. 5, p. 63–68, 86–87, 1967.

A single unique equation or relation does not exist for prediction of resistance to flow and average velocity of flow in sand channels. The reasons that a single unique relation does not exist are: (1) the configuration of the bed, (2) the properties of the fluid, (3) the drastic changes in turbulence characteristics with changes in flow, fluid, sand and channel geometry. However, if the bed configuration is known, it is possible to estimate flow resistance and average velocity. A relation between stream power and sand size is presented for determining the bed configuration, and equations are presented for estimating resistance to flow and average velocity. Authors' abstract

06175 **Rickert, D. A.; Tedrow, J. C. F.** Pedologic investigations on some aeolian deposits of northern Alaska: Soil Sci., v. 104, no. 4, p. 250–262, illus., tables, 1967.

The greatest sand dune area occurs in the vicinity of the Meade River eastward to the Colville River delta. Buried soil profiles (3,840 yr old) are common. The dunes are well developed and exist as well drained to xeric conditions adjacent to the river channels, but inland these dunes merge with the poorly drained tundra. From the dunes to the tundra, the organic matter content and the wetness factor increased but pH values decreased. The salt content remained nearly constant, and the C:N ratio followed no trend. Samples from near the tundra contained a little more silt plus clay than the dunes.—JWH

06283 **Ridge, J. D.** Zinc deposits of northeastern Tennessee—A genetic study [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B228, 1967.

06082 **Riley, R. A.; Davies, J. C.** Operation Lingman Lake, Stull Lake sheet, District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P. 426, scale 1 in. to 2 mi., 1967.

Riley, R. A. *See* Bennett, G. 06083

Riley, R. A. *See* Bennett, G. 06086

06026 **Rimsaite, J.** Optical heterogeneity of feldspars observed in diverse Canadian rocks: Schweizer. Mineralog. u. Petrog. Mitt., v. 47, no. 1, p. 61–76, illus., table, 1967.

Nearly one thousand Canadian rocks examined in thin sections are found to contain heterogeneous feldspars. Nine types of heterogeneity and five morphological types of alteration are distinguished and described. Distinctions are made on the basis of optical heterogeneity, and corresponding variations in chemical composition have been confirmed by chemical tests on a few samples. Occurrence and distribution of these feldspars in 200 rocks of diverse age, origin and type are summarized. Heterogeneity may result from environmental changes during crystal growth or from subsequent migration of ions. Migration of ions may be recognized from a study of heterogeneous feldspars and is particularly important for evaluation of chemical analyses and trace element studies.—Author's abstract

06191 **Rimsaite, J.** Biotites intermediate between dioctahedral and trioctahedral micas, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 375–393, illus., tables, 1967.

Orange-yellow detrital flakes of biotite commonly carry potassium and trace elements, but, because they differ in degree of alteration, it is difficult to find homogeneous material for comparison of properties with the original mica. Specimens from the nepheline deposit at Blue Mountain, Ontario, grading from orange-yellow to fresh brown, were studied along with a heated biotite. Chemical analyses, iron and minor elements, unit cell contents, and comparison of physical properties are tabulated. Chemical, physical, optical, and structural properties, and thermal behavior of fresh, weathered, and heated biotites are discussed. The orange-yellow biotites, intermediate between dioctahedral and trioctahedral micas, are a weathering product of iron-rich biotites and can be produced also by heating.—ESL

Ringwood, A. E. *See* Green, Trevor H. 00166

06361 **Rioult, Michel; Weyant, Marcel.** Relations géologiques entre les régions armoricaine et acadienne (Dérive des continents et ancienneté de l'Océan Atlantique Nord) [with English and German abs.]: Soc. Linnéene Normandie Bull., 10th ser., v. 8, no. 1, p. 72–91, illus., table, 1967.

Stratigraphic, paleontologic, tectonic, and morphologic affinities between the Armorican province in northwestern Europe and the Acadian province in northeastern North America show a close parallelism in the geologic history of these two areas, separated today by the Atlantic Ocean; the comparison fits naturally into the context of continental origin. Faunal liaisons indicate the existence of a common epicontinental marine basin for the two areas, developing at the end of the Caledonian and Variscan orogenies. Faunal exchanges took place from then on, progressing southward; by the end of the Paleozoic, the Armorican fauna resembled that of southern North America rather than that of the Acadian province, and in the Mesozoic, that of the Gulf of Mexico. Some genera and possible ocean currents involved are discussed. Cratonization of these blocks began very early and the ocean existed early in their history.—ESL

06064 **Ritzma, Howard R.** Oil impregnated sandstone deposits of Utah: Interstate Oil Compact Comm. Comm. Bull., v. 9, no. 2, p. 87–98, illus., 1967.

Field work in the summer of 1967 raised the number of known deposits of oil-impregnated rocks from 33 to 47. Deposits are grouped mainly in the Uinta basin in the northeast, and in central-southeastern Utah, with other scattered areas. The Uinta basin contains at least 21 deposits of oil-impregnated sandstone, mostly Eocene, besides oil shale, gilsonite, and oil and gas, including Red Wash field, one of the nation's largest. Six deposits are described as well as a number of those in the Triassic and Permian of the central southeast. Stratigraphic variation is

important in entrapment, and joints and fractures in migration. Upward migration in strongly folded and faulted areas may be extremely significant.—ESL

06136 **Roberts, George D.** Use of air to influence groundwater movement [with French summ.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 390–398, illus., 1967.

Air may be utilized as a barrier to migration of contaminated waters where proper permeability and structure are present. The advantages are: availability of air, ease of maintaining the air barrier, and comparatively low cost of operations. The great variety of topography, stratigraphy, structural conditions, permeability, and depth at which the barrier is to be installed and maintained will have important effects upon its design and operation. Techniques being employed to repressurize oil and gas fields and for storage of natural gas in underground reservoirs are reviewed. Simplified modifications could be employed to install and maintain an air barrier. Laboratory data are presented which indicate the effectiveness of air under varying pressures and permeability.—*from* Author's abstract

06397 **Roberts, R. J.; Ketner, K. B.; Radtke, A. S.** Geological environment of gold deposits in Nevada [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B228–B229, 1967.

Robinson, C. S. *See* Scott, J. H. 00376

06257 **Robinson, W. E.; Dinneen, G. U.** Constitutional aspects of oil shale kerogen [with French and Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 669–680, illus., tables, 1967.

Various tests were performed on 12 domestic and foreign oil shales to ascertain differences or similarities of the structure of kerogens and the composition of the soluble organic material associated with the kerogens. The oil shales varied in geologic age, environment, source material and elemental composition. The kerogens were studied by oxidative degradation, pyrolytic degradation and physical property analyses. The associated bitumens were studied by bitumen compositional analyses. The results of this study showed major differences in the structure of the kerogens and in the composition of the associated bitumens. Most of the differences appear to be related to geologic age, but in some instances the differences are related to source material or elemental composition.—Authors' abstract

06266 **Rod, Emile.** Paleotectonic reconstruction of the Antillean-Caribbean area for the close of the Carboniferous: Asoc. Venezolana Geología, Minería y Petróleo Bol. Inf., v. 10, no. 7, p. 196–204, illus., 1967.

It is noted that, in the review by Weyl (1965) on the paleogeographic evolution of the Central America–West Indies area, most authors use base maps having present day distribution and relative position of land and sea, in spite of frequent remarks on periods of great disturbances, of folding, faulting and considerable horizontal movements. Among suggestions on how to restore the displaced crustal fragments to pre faulting position, Carey (1958) found a key by rotating the Central American block back into the Gulf of Mexico. The present writer has worked out a modified version which can explain consistently all observations in the area, relative to Venezuela. A tentative reconstruction in different Mesozoic stages is presented in sketch maps. Experiment with it and criticism are invited.—GDC

Rohan, K. *See* Pirkovský, M. 06155

00296 **Rohrer, Willis L.** Geologic map of the Fish Lake quadrangle, Fremont County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ 724, scale 1:24,000, section, text, 1968.

There are no known fuel or metallic mineral deposits of economic value in the Fish Lake quadrangle; only small amounts of coal, gold, and monazite have been noted. Although no wells have been drilled for oil and gas, some potential sources seem to be in the Pennsylvanian Tensleep and Permian Phosphoria Formations.

Nonmetallic materials such as stone for riprap or road construction are available, and include basalt boulders, sandstone, limestone, dolomite, and quartzite gravel. Landslides are common because of large areas of incompetent Eocene strata and the high (about 35 inches) annual precipitation.—MCM

06314 **Rose, Arthur W.** Geology of the upper Chistochina River area, Mt. Hayes quadrangle, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 28, 41 p., illus., tables, geol. map, 1967.

The map area is on the south slope of the Alaska Range; the Denali strike slip fault crosses its north side. North of the fault early Paleozoic phyllites and graywackes are intruded by granite rocks; south of it, Mesozoic rocks intrude Pennsylvanian-Permian igneous and sedimentary rocks, and all are overlain by Tertiary volcanics and the Eocene Gakona Formation. Quaternary piedmont and valley glacier deposits are present. The Slate Creek fault parallels the Denali and is offset by a large thrust. Placer gold deposits at Slate Creek and Miller Gulch have produced over 3,000,000 dollars; the gold may have been deposited in parts of the Gakona and then reconcentrated. Stream sediments show several strong anomalies in copper, lead, and zinc along the Slate Creek fault zone.—*from* Author's abstract

Roseboom, Eugene H. *See* Takeda, Hiroshi. 05985

00342 **Rosen, Milton J.** Modification of the permeability of loess by electrolytes: Soil Sci., v. 105, no. 1, p. 51–56, illus., 1968.

It has been found that the intrinsic permeability and rate of infiltration of water into a loess soil can be increased significantly by treatment with solutions of salts of polyvalent cations. Treatments with solutions of polyvalent anions result in a marked decrease in permeability and rate of infiltration.—JWH

00177 **Ross, Malcolm; Papike, J. J.; Weiblen, Paul W.** Exsolution in clinoamphiboles: Science, v. 159, no. 3818, p. 1099–1102, illus., table, 1968.

Ten amphibole specimens from a variety of metamorphic rocks such as talc schists, eclogites, and metamorphosed iron formations contain lamellae of a second amphibole oriented parallel to (101) or (100), or both, of the host. Tremolites, actinolites, and hornblendes commonly have lamellae of a calcium-poor clinoamphibole with $P2_1/m$ space-group symmetry, or lamellae of cummingtonite with C2/m space-group symmetry. Likewise cummingtonites and $P2_1/m$ clinoamphiboles commonly contain lamellae of calcium-rich C2/m amphiboles such as tremolite. Results of X-ray diffraction, electron-probe, and microscope studies indicate that most lamellae result from unmixing of a homogeneous amphibole. The $P2_1/m$ clinoamphibole is analogous to the clinopyroxene pigeonite in agreement with the results of M. G. Bown [1966].—Authors' abstract

06120 **Ross, Malcolm.** Fourier transform analysis—[Pt.] 1, X-ray diffraction effects by finite montmorillonite and mica crystals [abs.], *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 47, 1967.

Roy, Rustum. *See* Barry, Thomas L. 05997

Roy, Rustum. *See* White, William B. 06010

06051 **Rozanov, A. Yu.** The Cambrian lower boundary problem: Geol. Mag., v. 104, no. 5, p. 415–434, illus., 1967.

Based on the study of distribution of assemblages of skeletal organic remains, the synchronous appearance of the skeleton in certain fossil groups is established; this enables us to draw the lower boundary of Cambrian according to the first zone with a certain assemblage of skeletal fossils. Wide distribution, in sections of various parts of the world, of deposits having no trilobites but containing similar assemblages of other skeletal fossils, has made it possible to distinguish them as an independent Tommotian Stage. The deposits of the Tommotian Stage are underlain by deposits

containing no skeletal fossils; in their carbonate composition they are, as a rule, rich in oncolites and catagraphs (algae of uncertain affinities or products of algal activity), and stromatoliths of so-called "Vendian" of "Yudomian" assemblage.—*from* Author's abstract

Rugg, A. M. *See* Schneidewind, N. F. 06301

06385 **Ruhe, Robert V.** Geomorphic surfaces and surficial deposits in southern New Mexico: New Mexico Bur. Mines and Mineral Resources Mem. 18, 66 p., illus., tables, geol. map, 1967.

Bedrock types in Dona Ana County are Paleozoic sedimentary rocks, Tertiary volcanic rocks, and monzonite intrusives. Mountains are block-faulted, with major faults along the fronts. The Dona Ana Mts. are an ellipsoidal dome whose major axis parallels the fault-controlled Rio Grande trench and Robledo fault. Alluvial fans, piedmonts, and aprons; basins and scarplet surfaces; and valley-border surfaces, ranging in age from mid-Pleistocene to historic, are described; the geometry of projected profiles is shown on graphs. The texture, composition, layering, weathering, and carbonate horizons of surficial deposits are discussed. Maps accompanying the report include: geomorphic surfaces, and bedrock and surficial deposits of the Las Cruces area; drainage patterns, and fit of geometry to topography on Dona Ana Mtn. dome.—ESL

00191 **Rupert, R. J.; Lovell, H. L.** Bernhardt Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 446, scale 1 in. to 1/4 mi., text, 1968.

All rock units are of Archean age with basalt predominating in lower portions and more felsic andesites and dacites at higher levels. Only a few north-trending dikes of the Matachewan swarm were found, mainly in the west. Predominant structural features are an anticline and two flanking synclines. Strong north-striking lineaments mark a set of faults, most with left-hand separation; these may be tear faults related to tighter folding westward. NE-trending lineaments indicated by the outcrop pattern near Goodfish Lake appear to be related to ore structures at Kirana and Goodfish mines. Areas which merit close geophysical examination are between Little Cameron and Splashwater Lakes (iron sulfide mineralization with minor copper) and near Kellet Lake (above average iron sulfides). The southeastern area is worth prospecting for nickel; some shallow intrusions are potential hosts or sources for copper, molybdenum, and gold.—MCM

00192 **Rupert, R. J.; Lovell, H. L.** Morrisette Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 447, scale 1 in. to 1/4 mi., text, 1968.

All bedrock in Morrisette Township is Archean; the lowest portion consists of andesites and basalts with thin interflow sedimentary rocks to the south. Except for one hornblende lamprophyre dike to the north, no intrusives exist in felsic volcanic rocks above the sedimentary rocks. The Murdoch Creek-Kennedy Lake and Misema Lake-Mist Lake faults are exposed as shear zones more than 300 feet wide. The Morrisette Creek fault is indicated only by a lineament for most of its length, but east of Nettie Lake more than 20 feet at the edge of a shear zone is exposed. One of several NE-trending lineaments appears to be related to gold prospects to the north. An area southeast of Morrisette Lake, where iron sulfides with copper are exposed in flow tops, is recommended for geophysical prospecting. Gold is found mainly in or near shear zones near granitic dikes and plugs. Eskers are potential sources for sand and gravel.—MCM

06228 **Russell, Ernest E.** Geologic map of the Chewalla quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 4-SW, scale 1:24,000, separate text, 1967.

The text, "Mineral resources summary of the Chewalla quadrangle, Tennessee," by L. T. Larson is cited separately.—MCM

06229 **Russell, Ernest E.** Geologic map of the Reagan quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 11-SE, scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Reagan quadrangle, Tennessee," by R. E. Hershey is cited separately.—MCM

Russell, Ernest E. *See* Wilson, Charles W., Jr. 06230

00372 **Russell, R. D.; Slawson, W. F.; Ulrych, T. J.; Reynolds, P. H.** Further applications of concordia plots to rock lead isotope abundances: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 284–288, tables, 1967 [1968].

Concordia-type plots of isotopic abundances of lead in rocks and minerals, as proposed by Ulrych, are applied to leads from Balmat, N.Y., and from Vesuvius, Italy; in all cases, the data are obtained from published literature. It is pointed out that the procedures can be extended to evaluate the U-238/Pb-204 ratios for the first stage of the two-stage model assumed. The values thus obtained for the data available are in surprisingly good agreement and, when normalized to the same value for the age of the Earth, give a mean value for the eight suites of samples equal to 8.70±0.12. This value is compared with values found by Ostic, Russell, and Stanton, and it is concluded that any systematic difference might be accounted for by discrimination in the mass spectrometer techniques.—*from* Authors' abstract

06362 **Sainsbury, C. L.; Hamilton, John C.; Huffman, Claude, Jr.** Geochemical cycle of selected trace elements in the tin-tungsten-beryllium district, western Seward Peninsula, Alaska—A reconnaissance study: U.S. Geol. Survey Bull. 1242-F, p. F1–F42, illus., tables, geol. map, 1967.

Tin, beryllium, boron, lithium, tungsten, copper, lead, zinc, and niobium moved outward from biotite granite stocks, richer in beryllium than most tin granites. Clear-cut evidence of the passage of the mineralizing solutions is present in contact rocks and minerals and in individual minerals of the zoned tin-beryllium-fluorite deposits. Except possibly for zinc and silver, all the elements investigated remained associated during the geochemical cycle. Anomalous amounts of many rare elements in igneous rocks can best be detected by the analyses of bulk heavy-mineral fractions having a specific gravity greater than methylene iodide (3.29).—CLS

Salome, Michel. *See* Gradsztajn, Eli. 00212

Sand, L. B. *See* Regis, A. J. 06203

06177 **Sartz, Richard S.** A test of three indirect methods of measuring depth of frost: Soil Sci., v. 104, no. 4, p. 273–278, illus., tables, 1967.

Depth of bonded frost penetration was measured by four methods: change in resistance of soil moisture blocks, temperature as measured by thermistors, soil test frostmeters, and a modified frost penetrometer. The direct reading penetrometer was a check on the indirect methods. Resistance-block determinators agreed well with the penetrometer methods. Variable temperatures in the frozen layer lead to the conclusion that temperature alone is a poor indicator of frozen soil. The frostmeter was found to be unreliable.—JWH

Sasaki, A. *See* Folinsbee, R. E. 06286

00347 **Satterly, J.** (compiler). Aeromagnetic maps of carbonatite-alkalic complexes in Ontario: Ontario Dept. Mines Prelim. Map P. 452, text, 1968.

The map sheet includes an index map (scale about 1 in. to 67 mi.), and 26 insets from the Canada Geol. Survey Geophys. Papers series (scale 1 in. to 2 mi., unless otherwise noted). The 32 mafic alkalic complexes are listed in a table, even though little is known about their geology. Many complexes have been found by aeromagnetic or aeroradiometric surveys. In the simplest complexes, carbonatite cores show as a central magnetic low, and surrounding concentric highs may be caused by either magnetite-bearing carbonatite or rings of alkalic rock. More complex rock relationships and mineralized bodies containing magnetite as an essential mineral are revealed by lenticular, high anomalous areas. Detailed ground magnetometer surveys combined with distribution of boulder erratics, and scintillometer surveys are also effective in exploration. A continuing program of

aeromagnetic surveys has revealed numerous, previously unknown, complexes.—MCM

00199 **Satyanarayana, B.** Special problems in slope stability—Discussion [of paper 5328 by W. J. Turnbull and M. J. Hvorslev, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 5827, Jour. Soil Mechanics and Found. Div., no. SM2, p. 604–605, 1968.

The writer hopes that the authors of paper 5328 [ibid., v. 93, no. SM4, p. 499–529, 1967] can suggest changes that are to be made in the regular methods of slope-stability analysis in the case of earth dams constructed with expansive soils.—ESL

Sauer, Herbert I. *See* Banta, James E. 06213

06316 **Sawatzky, P.** Experimental ship-based helicopter aeromagnetic survey: Canada Geol. Survey Paper 67-20, 36 p., illus., 1967.

The problems inherent in using a magnetometer on board a ship-based helicopter are discussed and the adaptations of equipment required and the techniques employed are described. The author concludes that the efficiency of magnetometer surveys conducted at sea can be increased by using helicopters, and that the skill and initiative of the personnel involved in the project is of great importance. Author's abstract

06107 **Sawhney, B. L.** Interstratification in vermiculite, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 75–84, illus., tables, 1967.

Successively increasing additions of K or Cs to an expanded lattice of vermiculite containing a hydrated interlayer cation, Ca, first collapsed alternate layers, resulting in the formation of a regularly interstratified 25.2A mica-vermiculite intermediate, verified by a one-dimensional Fourier analysis. Further additions collapsed the entire mixture to a 10A mica lattice. A mechanism was postulated to explain the collapse of alternate layers: the replacement of interlayer Ca and water in one layer reduces the effective negative charge on the adjacent layer, so that K cannot replace the hydrated Ca in this layer, but replaces it in the next. The diagenetic formation of illitic materials from the expanded layer silicates may proceed through a regularly interstratified layer sequence as in this study.—*from* Author's conclusion

06165 **Sayre, William W.; Conover, W. Jay.** General two-dimensional stochastic model for the transport and dispersion of bed-material sediment particles [with French abs.], Paper B10 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 2: Fort Collins, Colo., Colorado State Univ., p. 88–95, illus.; discussion and reply, ibid., V. 5, p. 246–248, 255–256, 1967.

The transport of bed-material sediment particles in an alluvial channel is represented as a stochastic process consisting of a sequence of longitudinal and vertical displacements of random magnitude between which there are rest periods of random duration. In order to apply the model, the probability density functions for (1) the step lengths, (2) the rest period durations given the elevation at which a particle is deposited, and (3) the elevation at which a particle is deposited, must be known. Methods for the experimental evaluation of these functions are suggested.—Authors' abstract

Scarbrough, W. Leon. *See* Joiner, Thomas J. 06376

06380 **Schaeffer, Bobb.** Osteichthyan vertebrae: Linnean Soc. London Jour.,Zoology, v. 47, no. 311, p. 185–195, illus., 1967.

Aspects of the ontogeny and phylogeny of osteichthyan vertebrae are summarized and interpreted on the basis of a study of living and fossil fishes and embryonic material. It is noted in summary that there is no evidence in the osteichthyans of a sclerocoel that divides the sclerotome into cranial and caudal halves; sclerotomic resegmentation in the tetrapod sense is therefore absent. Neither the arch anlagen

nor the intercalaries are directly involved in the formation of the osteichthyan centrum. Dorsal and ventral intercalaries, chondrified or ossified, are present in some lower actinopterygians and presumably in some dipnoans and rhipidistians. The arch components and the centra are clearly homologous throughout the osteichthyans and the tetrapods in spite of sclerotomic resegmentation in the latter.—GSA Bib. Staff

06429 **Scheidegger, Adrian E.; Potter, Paul Edwin.** Bed thickness and grain size—Cross bedding: Sedimentology, v. 8, no. 1, p. 39–44, illus., 1967.

Qualitative and quantitative observations show the general positive correlation between grain size and thickness of cross-bed units. Greater sand-wave height correlates with greater turbulence which permits more and coarser grains to be transported. A theory is derived which qualitatively explains these relationships.—Authors' summary

06005 **Schenk, Paul E.** Facies and phases of the Altamont Limestone and megacyclothem (Pennsylvanian), Iowa to Oklahoma: Geol. Soc. America Bull., v. 78, no. 11, p. 1369–1383, illus., tables, 1967.

The Altamont Limestone of the Desmoinesian Series is a thin unit which crops out for more than 460 miles along the eastern flank of the Western Interior basin. The formation consists of an older Amoret Limestone and a younger Worland Limestone, and an intervening Lake Neosho Shale, which is characterized by a median black phosphorite. The formation is the marine portion of the Altamont cyclothem, which was produced by a single transgressive-regressive cycle of the strand line. Carbonates are shallow-water facies, shales are deep-water facies, and phosphate precipitation occurred during maximum marine transgression. Water depth was the controlling factor in vertical and lateral distribution of lithosomes and biosomes. Eustatic change rather than diastrophism appears to best explain the megacyclothem.—*from* Author's abstract

06417 **Schindler, Paul W.** Heterogeneous equilibria involving oxides, hydroxides, carbonates, and hydroxide carbonates, [Chap.] 9 *in* Equilibrium concepts in natural water systems—Am.Chem.Soc., 151st Ann.Mtg., Pittsburgh, 1966, Water,Air and Waste Chemistry Symposium: Washington,D.C., Am.Chem.Soc.(Adv.Chemistry Ser.67), p. 196–221, illus., tables, 1967.

Some major and minor constituents of sea water can be classified with respect to possible control of their concentrations by simple solubility equilibria. Comparing calculated and observed data leads to the conclusion that the ocean represents a steady-state system, where the degree of oversaturation bears a reasonable relationship to the rate of sedimentation.—Author's abstract

06430 **Schlee, John; Webster, Jacqueline.** A computer program for grain size data: Sedimentology, v. 8, no. 1, p. 45–53, illus., tables, 1967.

A program to improve estimation of statistical parameters for grain-size data by use of interpolated values is presented. Interpolation is made by fitting a series of overlapping parabolas to the data, and follows the method of Snyder (1961). Moment formulas result, and are used to compute standard statistical measures. Skewness and kurtosis are reduced. The program also finds major modes, the median, and sedimentary type.—*from* Authors' summary

Schmidt, Paul W. *See* Andrews, Donald E. 06188

06019 **Schmincke, Hans-Ulrich.** Stratigraphy and petrography of four upper Yakima Basalt flows in south-central Washington: Geol. Soc. America Bull., v. 78, no. 11, p. 1385–1422, illus., tables, 1967.

The upper part of the upper Tertiary Yakima Basalt, which is the upper part of the Columbia River group, consists of four widespread tholeiitic basalt flows, which are from oldest to youngest the Umatilla, Pomona, Elephant Mountain, and Ward Gap Basalts. Correlation of these flows is based on primary structures, degree of weathering, petrography, and chemical composition. Each flow has a characteristic,

in part unique, chemical composition. Within flows variations in texture and mineral composition are common, and are determined by crystallinity, which depends on cooling history. Discontinuous layers of continental sedimentary rocks, members of the Ellensburg Formation, are locally interbedded with the basalt flows.—WHN

06301 **Schneidewind, N. F.; Rugg, A. M.** Proposed shipboard computer requirements for undersea mining exploration, *in* The new thrust seaward—MTS Conf. and Exhibit, 3d Ann., San Diego, Calif., 1967, Trans.: Washington, D. C., Marine Technology Soc., p. 115–126, illus., tables, 1967.

The greatest utility of a shipboard computer system for undersea mining exploration is in providing a capability for analyzing large quantities of data during, rather than after, a survey. Thus, it is possible to modify the conduct of a survey as results are observed—a real time system. Data requirements and a two ship operation, one for underway and the other for on-station measurements, are described. Specifications for a shipboard computer system are derived from the data requirements; real time system requirements are discussed. Computer system specifications include general real time characteristics, data base and storage requirements, input devices, output presentations, reliability requirements, software requirements, equipment configuration and cost.—*from* Authors' abstract

Schnitzer, M. *See* Kodama, H. 06195

Schoewe, Walter H. *See* Bayne, Charles K. 05980

00280 **Scholz, C. H.** Experimental study of the fracturing process in brittle rock: Jour. Geophys. Research, v. 73, no. 4, p. 1447–1454, illus., table, 1968.

Many small cracking events or microfractures precede fracture in laboratory compression tests on rock. Each event radiates elastic waves. During the compression of granite to fracture, 22 of the largest microfracture events were located in space by using first arrivals of S waves detected with a multitransducer array. At about 92 percent of the fracture stress, a rapid acceleration of microfracturing activity occurred. The location of the events that occurred below this point showed no obvious relation to the eventual fault. At stresses within the region of accelerated activity, however, there was a marked clustering of microfractures on the eventual fault plane. These observations suggest that the approximate time and place of fracture could have been predicted. In the light of the similarity of microfractures and earthquakes, this suggests a possible method for predicting earthquakes.—Author's abstract

00282 **Scholz, C. H.** Microfracturing and the inelastic deformation of rock in compression: Jour. Geophys. Research, v. 73, no. 4, p. 1417–1432, illus., tables, 1968.

Experimental study of cracking during deformation of rocks in compression shows that the pattern of crack occurrence for a wide variety of rocks, at confining pressures up to 5 kb, was closely related to stress-strain behavior. Dilatancy in the region above half the fracture stress was directly proportional to cracking. Cataclastic deformation of marble was similar to frictional sliding but distinctly different from brittle deformation; with increasing pressure (to 4 kb) marble underwent a gradual transition from cataclastic to fully plastic flow. A model of deformation in inhomogeneous brittle material is proposed, according to which microfracturing events in the dilatant region below 95 percent of the fracture stress are randomly independent, but at higher stresses are not independent and are correlated with the formation of the fault.—DBV

00285 **Schreiber, B. Charlotte.** Sound velocity in deep sea sediments: Jour. Geophys. Research, v. 73, no. 4, p. 1259–1268, illus., 1968.

In this study, data were obtained from 42 late Pleistocene to Recent deep-sea cores taken in the North Atlantic and Caribbean. The relations previously found for velocity versus porosity and for velocity versus median diameter were found to hold for our data. Deviations from these relations were caused by: (1) high percentage biogenic content that yielded a high porosity for any given median diameter and

a resultant lower velocity, (2) presence of particular minerals that did not seem to behave as independent grains but rather as a gel, exhibiting a very low velocity, (3) poorly sorted sediments that, depending on their component modes, seemed to result in both elevated and reduced velocities. As a consequence, the relation of velocity to porosity and to median diameter is more clearly defined, and the variations exhibited by atypical materials are explained.—*from* Author's abstract

06264 **Schreiber, H. A.** Digital computer program for particle-size distribution and textural classification of soils: Soil Sci., v. 104, no. 3, p. 225–226, table, 1967.

A Fortran II source program was written to determine particle-size distributions and textural classifications of soil samples. The method of calculation is a derivation of the two point method, and a correction is applied to adjust for depth discrimination.—Author's summary

06033 **Schultz, C. Bertrand; Falkenbach, Charles H.; Vondra, Carl F.** The Brule-Gering (Oligocene-Miocene) contact in the Wildcat Ridge area of western Nebraska—A guide for the stratigraphic collecting of fossil mammals: Nebraska Univ. State Mus. Bull., v. 6, no. 4, p. 43–58, illus., 1967.

In Scotts Bluff County the contact between these two formations is defined as 129 feet above the base of the "Upper Ash" bed, which corresponds to the upper portion of Darton's (1899) "sandy phase" in the upper part of the Brule. Certain key beds in the Gering Formation can be traced laterally from a channel facies to a proximal-floodplain facies, then to a distal-floodplain facies, and finally to an interstream-divide facies. The sediments of the latter two facies are massive and very fine-grained. Significant localities for observing the facies problems of the Gering Formation are to be found along Wildcat Ridge in Banner County and Castle Rock in Scotts Bluff County, Neb.—*from* Authors' abstract

Schweiger, F. *See* Godfrey, L. M. 00183

06190 **Scott, A. D.; Smith, S. J.** Visible changes in macro mica particles that occur with potassium depletion, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 357–373, illus., table, 1967.

Mica particles were placed in NaCl-NaTPB solutions to note changes that occur when interlayer K is replaced by Na; effects of different degradation periods were photographed. An increase in thickness due to basal planes splitting apart releasing interlayer K was observed with all micas, and in some caused particles to cleave into separate flakes. Lepidomelane remained intact despite a 20 fold increase in thickness in 7 days. Muscovite and lepidolite exfoliated and cleaved, but needed much longer degradation periods. There was a distinct color change in dark biotite, phlogopite, and lepidomelane when K was removed., so that initial stages of depletion at holes, scratches, and edges were easily followed; as degradation progressed, color became a less reliable index. Visual evidence of depletion at edges was also obtained with muscovite, but not lepidolite. Transverse sections of biotite were photographed to show edge expansion.—*from* Authors' abstract

00376 **Scott, J. H.; Lee, F. T.; Carroll, R. D.; Robinson, C. S.** The relationship of geophysical measurements to engineering and construction parameters in the Straight Creek Tunnel pilot bore, Colorado: Internat. Jour. Rock Mechanics and Mining Sci., v. 5, no. 1, p. 1–30, illus., table, 1968.

Seismic refraction and electrical resistivity measurements along the walls of the Straight Creek Tunnel pilot bore indicate both a low-velocity and high-resistivity layer in the disturbed rock around the excavation. The electrical resistivity and seismic velocity of rock at depth, thickness of rock in the low-velocity layer, and relative amplitude of seismic energy were correlated against parameters of importance in tunnel construction (height of tension arch, stable vertical load, rock quality, etc.). Results were found to be statistically meaningful, and suggest the possibility of predicting parameters of interest from geophysical measurements in feeler holes drilled ahead of the working face.—VSN

Scott, L. O. *See* Phizackerley, P. H. 06254

Scott, Martha R. *See* Turekian, Karl K. 06414

Scott, Verne H. *See* Esmaili, Houshang. 00195

Scott, Verne H. *See* Kriz, George J. 00268

Seed, H. Bolton. *See* Thiers, Gerald R. 00324

00337 **Seiglie, George A.; Poag, C. W.** Notes on the synonymy of *Reichelinella* and *Arcanispira*: Cushman Found. Foram. Research Contr., v. 19, pt. 1, p. 30–31, illus., 1968.

Better preserved specimens of *Reichelinella* are described inasmuch as the original descriptions are poor, and because *Reichelinella* is considered to include *Arcanispira*. They are from the Miocene Chipola Formation in Florida.—HRC

06126 **Sellman, Paul V.** Geology of the USA CRREL permafrost tunnel, Fairbanks, Alaska: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Tech. Rept. 199, 22 p., illus., tables, 1967.

A perennially frozen Quaternary silt section in the tunnel near Fairbanks, Alaska, proved to be late Wisconsin, with a maximum C-14 date of 33,700 (+2,500, −1,000). Ice wedges occur throughout the section, and their scattered vertical distribution, truncated flat tops, and second cycle growth suggest changing depositional and/or climatic conditions. There are two unconformities, one at a depth of 30 feet indicated by: a jump in C-14 dates from 14,000 to 30,000, 20-fold increase in chemical concentration with depth, and sudden occurrence of large wedge structures showing second cycle growth. The upper break at 10 feet, suggested by C-14 dates and a small truncated ice wedge, may indicate a warming period.—ESL

Sengbush, R. L. *See* McDonal, F. J. 06453

Shainberg, I. *See* Kemper, W. D. 06315

Sharp, Byron J. *See* Cohenour, Robert E. 00371

00355 **Sharp, William N.; Gualtieri, James L.** Lead, copper, molybdenum, and zinc geochemical anomalies south of the Summitville district, Rio Grande County, Colorado: U.S. Geol. Survey Circ. 557, 7 p., illus., 1968.

An extensive lead geochemical anomaly as well as several smaller anomalies of copper, molybdenum, and zinc, have been found in a large area of altered volcanic and intrusive rocks south of the Summitville mining district. These geochemical anomalies, together with the geologic similarity to the productive Summitville district, make the area attractive for further exploration.—Authors' abstract

Sheppard, Richard A. *See* Gude, Arthur J., 3d. 06201

06073 **Sherburne, Roger W.** Rayleigh wave phase velocity profile from Golden, Colorado, to Albuquerque, New Mexico: Earthquake Notes, v. 38, no. 1, p. 5–14, illus., tables, 1967.

Phase velocities of Rayleigh waves in the period range of 18 to 60 sec were determined between the seismograph stations at Golden, Colorado, and Albuquerque, New Mexico. The average phase velocity for the 50-sec waves is significantly below the average continental value of 4.0±0.1 kmps. However, the observed and theoretical values of phase velocity are in good agreement with a three-layer crustal model 59 km thick, similar to the one proposedby Smith (1962).—Author's abstract

Shi-igai, Hiroyoshi. *See* Kikkawa, Hideo. 06174

00341 **Simmons, Gene.** Geophysics—Some recent highlights: Geotimes, v. 13, no. 2, p. 17–18, 1968.

Recognition of scientific contributions that may prove to be significant is difficult; views may be biased, and in the volume of present-day literature ideas may be overlooked for some time. The present most exciting concept is that of sea-floor spreading, an idea vaguely suggested in 1881. Only within the last year or two have sufficient data become available to make the idea convincing. In addition to magnetic data, the patterns of heat flow anomalies, and locations and fault-plane solutions of earthquakes seem to be consistent with the concept. From various observations, the core of the Earth seems to be larger by 10 to 20 km than long believed, and the density less than its assumed iron-nickel composition. The era of earthquake prediction is just beginning.—GDC

06252 **Simon, R.** Rock failure in bore-hole drilling [with French abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 67–74, illus., tables, 1967.

The various kinds of rock failure observed in laboratory cratering experiments are discussed and compared with those obtained in rock mechanics investigations performed under analogous, but macroscopically homogeneous, conditions. It is shown how such rock mechanics considerations contribute to better understanding of the factors that affect the values of the two most significant phenomenological parameters for analyses of rotary, percussive and vibratory drilling, namely, 1) the force-penetration characteristics of bits, and 2) the energy expended per unit volume of rock drilled. Research, aimed at developing possible means for enhancing those failure modes leading to improved drilling methods, is discussed.—Author's abstract

06164 **Simons, Daryl B.** River hydraulics, *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 5: Fort Collins, Colo., Colorado State Univ., p. 376–398, illus., tables, 1967.

Water resources development encompasses use of knowledge from many fields such as hydraulic engineering, hydrology, geology, agriculture, economics, watershed management and related areas. Full use of existing and developing concepts and theories should better solve current problems and meet challenges of tomorrow. Piecemeal development of new knowledge and its application must be replaced by an interdisciplinary integrated approach with problems evaluated on a river basin or regional basis. The geomorphology of rivers involves numerous interrelated variables, difficult to measure, both in time and space. Emphasis here includes bed configuration, energy gradient, meanders, flow regimes, river bars, and sediment transport relationships. For large rivers the approach (Colby, 1964) based on data from large and small rivers and flumes is superior.—GDC

Simons, Daryl B. *See* Chang, Feng-Ming, 06167

Simons, Daryl B. *See* Richardson, Everett V. 06168

00202 **Simpson, John F.** Solar activity as a triggering mechanism for earthquakes: Earth and Planetary Sci. Letters, v. 3, no. 5, p. 417–425, illus., 1967 [1968].

Solar activity, as indicated by sunspots, radio noise, and other geomagnetic indices, plays a significant but by no means exclusive role in the triggering of earthquakes. Maximum quake frequency occurs at times of moderately high and fluctuating solar activity. Terrestrial solar flare effects which are the actual coupling mechanisms which trigger quakes appear to be either abrupt accelerations in the Earth's angular velocity or surges of telluric currents in the Earth's crust. The graphs presented in this paper permit probabilistic forecasting of earthquakes, and when used in conjunction with local indicators may provide a significant tool for specific earthquake prediction.—Author's abstract

Singh, R. N. *See* Folinsbee, R. E. 06286

Slawson, W. F. *See* Russell, R. D. 00372

06118 **Sloane, Richard L.; Guilbert, John M.** Electron-optical study of alteration to smectite in the Cheto clay deposit, *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 35–44, illus., 1967.

Volcanic ash of latitic composition in the Pliocene Bidahochi Formation of northeastern Arizona has been altered in place to a 4-ft thick bed of high-quality smectite clay. Samples of transitional materials showing progressive alteration from vitric tuff toward massive smectite were examined petrographically, electron-optically, and by X-ray diffraction. Several clearly identified structures relatable to fresh material were shown, but X-ray diffraction reveals only montmorillonite. Argillization involves: development of layering or banding in the glass, development of a braided surface aspect, inception of arcuate subparallel lineations on internal curved surfaces of the glass, growth of pseudohexagonal, weakly curled flakes, and growth of grossly hexagonal matted granular networks in completely altered glass. Bladed, comb-like smectite develops along interfaces between glass and more resistant shards.—*from* Authors' abstract

06142 **Smalley, I. J.** A simple model of a diagenetic system: Sedimentology, v. 8, no. 1, p. 27–33, illus., 1967.

At the moment of deposition an ideal sediment has certain topological properties. The diagenesis process is driven by the reduction of surface area, and this process is considered in relation to the topological properties. The connectivity and genus increase as cementation occurs and in some systems may decrease again. Relations between genus, density, depth of burial, and time are considered for a sand-sandstone system.—*from* Author's summary

06143 **Smalley, I. J.** The presentation of subjective shape and roundness data: Sedimentology, v. 8, no. 1, p. 35–38, illus., 1967.

If a modified version of the Zingg system is used, particles can be subjectively classified into four shape classes. The roundness of a particle can be estimated by assessing the flat/convex/concave ratio and can then be represented as a point on a triangular net; this point can also indicate the Zingg classification of the particles.—Author's summary

Smith, Alan R. *See* Wollenberg, Harold A. 00271

06360 **Smith, Arthur R.** Petrography of six granitic intrusive units in the Yosemite Valley area, California, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 91, p. 2–15, illus., tables, 1967.

Petrographic examination of specimens from these six units suggests a need to reclassify four of them, although megascopic descriptions by F. C. Calkins (1930) are excellent and his contacts have stood the test of time. Based on recent modal data, it follows that: the Biotite granite of Arch Rock is actually granodiorite, the Granodiorite of the "The Gateway" is quartz diorite, El Capitan Granite is granodiorite, and Taft Granite is quartz monzonite; the Sentinel Granodiorite and Half Dome Quartz Monzonite were correctly classified. Diagnostic microscopic features are tabulated with grain size, megascopic features, texture, accessory minerals, alteration features, and plagioclase composition.—GDC

06105 **Smith, Douglas; Albee, Arden L.** Petrology of a piemontite-bearing gneiss, San Gorgonio Pass, California: Contr. Mineralogy and Petrology, v. 16, no. 3, p. 189–203, illus., tables, 1967.

Equilibria between different valence states of Fe and Mn have been studied in a microcline-plagioclase-quartz gneiss which locally contains ferromagnesian minerals unusually high in Mn^{+3} and Fe^{+3} and low in Fe^{+2}. Minerals in some layers were formed under highly-oxidizing conditions and in others under less. Differences in oxidation of Fe and Mn occur between adjacent layers and probably reflect sedimentary differences. Fe and Mn different valences are sharply partitioned

between coexisting phases. In highly oxidized layers, muscovite has more Fe than coexistent phlogopite; in piemontite most Mn is trivalent, and in coexistent garnet divalent. In less-oxidized layers, epidote has no Mn^{+3} and less Mn^{+2} than coexistent garnet, biotite, or amphibole. In coexistent garnet and piemontite, Fe^{+2} and $^{+3}$, Mn^{+2} and $^{+3}$ are present.—*from* Authors' abstract

Smith, George E. *See* Keller, W. D. 06218

06138 **Smith, H. F.** Artificial recharge and its potential in Illinois [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 136–142, illus., tables, 1967.

A definite relationship has been shown between grain size of filter blankets and percent of sediment that penetrated the aquifer through a recharge pit. High rates of recharge have been achieved under certain conditions where filter grain size was optimum, the pit the correct shape, and permeability high. Criteria established for evaluating recharge potential of aquifers include: thickness of aquifer, areal extent of aquifer, and minimum economical withdrawal rate; as well as limits of turbidity, temperature, and mineral and bacteriological quality of recharge water. These criteria were applied to areas of Illinois; estimates were made of potential artificial recharge into surface sands and gravels, particularly in northeastern Illinois where population is dense and where withdrawal exceeds natural and induced recharge.—*from* Author's abstract

00182 **Smith, Neal J.** The Society of Exploration Geophysicists—A professional society: Geophysics, v. 33, no. 1, p. 1–7, illus., 1968.

The purposes, makeup, and organization of the Society of Exploration Geophysicists are reviewed.—DBV

Smith, S. J. *See* Scott, A. D. 06190

00288 **Smith, Thomas E.** Aeromagnetic measurements in Dixie Valley, Nevada—Implications in basin-range structure: Jour. Geophys. Research, v. 73, no. 4, p. 1321–1331, illus., table, 1968.

Aeromagnetic survey results suggest that basement rocks under Dixie Valley, Nevada, form a composite asymmetric graben roughly parallel to the valley axis. The inner graben block, about 5 km wide, underlies the western half at an average depth of 1.9 km. Between this and bordering ranges are shelf blocks, less downthrown with respect to the ranges. Average basement depth under the whole valley is 765 m below the present surface. Contacts of an intrabasement gabbroic complex can be traced across northern and southern Dixie Valley. Post-Jurassic movements on the major fault systems seem to have been primarily dip-slip. The anomaly over the southern gabbro contact confirms the lopolithic form of the complex; the three-dimensional anomaly in southeastern Dixie Valley may be caused by a volcanic cone or equidimensional volcanic remnant.—DBV

Sniegocki, R. T. *See* Johnson, A. I. 06125

06275 **Sörensen, Henning.** Hydrothermal veins in the Ilímaussaq intrusion [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B230, 1967.

06327 **Southwick, David L.; Fisher, George W.** Revision of stratigraphic nomenclature of the Glenarm Series in Maryland: Maryland Geol. Survey Rept. Inv. 6, 19 p., illus., table, geol. map, 1967.

The Glenarm Series, of probable late Precambrian age, consists of the Setters Formation at the base, the Cockeysville Marble, and Wissahickon Formation. The Wissahickon is redefined to include the earlier Wissahickon, and rocks previously termed Peters Creek, Sykesville, and Laurel Formations; it is subdivided into five mappable lithofacies. This reduction of formations to lithofacies is necessary in order to retain the name Wissahickon Formation for the whole schist-metagraywacke complex of the Glenarm, a usage desirable in light of previous usage and geologic relations; it also emphasizes their local character. A chart comparing

earlier nomenclature with that proposed is given, and a simplified geologic map of the eastern Maryland Piedmont accompanies the report.—*from* Authors' summary

06021 **Speaight, Robert.** The life of Teilhard de Chardin: New York, Harper and Row, 360 p., illus., 1967.

Squarer, David. *See* O'Loughlin, Emmett M. 06162

00320 **Stanley, Daniel J.** Comparing patterns of sedimentation in some modern and ancient submarine canyons: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 371–380, illus., 1967 [1968].

An attempt is made to compare probable submarine canyon deposits of Tertiary age well exposed in the French Maritime Alps with the Pleistocene–Holocene sediment fill of the Gully submarine canyon on the continental margin off Nova Scotia. Similarities in geometry, stratification, texture, and assemblages of sedimentary structures are remarkable. A comparison of modern and fossil analogs provides marine geologists with an additional tool for better interpreting the mechanism of sediment dispersal in modern canyons which remain logistically difficult to study, and enable stratigraphers to recognize submarine valley deposits preserved in the fossil record.—*from* Author's abstract

Stanley, Daniel J. *See* James, Noel P. 06058

06390 **Stanton, Robert J., Jr.** The effects of provenance and basin-edge topography on sedimentation in the basal Castaic Formation (upper Miocene, marine), Los Angeles County, California, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 92, p. 21–31, illus., table, geol. maps, 1967.

The basal Castaic Formation illustrates the relationship between sedimentation at the margin of a transgressing sea and the nature of the land being transgressed. The sediments, ranging from cobble–boulder conglomerate to well sorted sandstone, reflect the strata, structural deformation, and topographic relief of their local source areas. Most important factors were the relief of the adjacent land and texture of sediment that could be derived from it. On the basis of contained fossils it appears that wedge- and lens-shaped bodies of sand and gravel along the steep rocky shore were deposited in shallow water, but are poorly preserved because they were reworked and redeposited as tongues extending offshore into deeper water mud and sand. These tongues comprise the bulk of the basal strata of the Castaic Formation.—GDC

06028 **Starkey, John.** on the relationship of pericline and albite twinning to the composition and structural state of plagioclase feldspars: Schweizer. Mineralog. u. Petrog. Mitt., v. 47, no. 1, p. 257–268, illus., table, 1967.

Published crystallographic data from X-ray analyses of 105 plagioclase feldspars have been collected and, where possible, the complete lattice angles have been calculated. From these data the orientation of the rhombic section and the obliquity of albite twins have been determined and the dependence of these parameters on both composition and structural state is demonstrated. It is shown how information concerning the history of a plagioclase crystal may be obtained by measuring the orientation of the composition planes of secondary pericline twins. The possible influence of the obliquity on twinning is also discussed. It is suggested that the ease of development of glide twins in the plagioclase feldspars is related to the crystal structure.—Author's abstract

Stearn, R. T. *See* Carlson, R. C. 00184

06227 **Stearns, Richard G.; Ferguson, Carl C.** Geologic map of the Beans Creek quadrangle, Tennessee (including the Tennessee portion of the Estill Fork quadrangle, Alabama–Tennessee): Tennessee Div. Geology Geol. Map GM 87 SW, scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Beans Creek quadrangle, Tennessee," by C. C. Ferguson is cited separately.—MCM

06424 **Steinhart, John S.** Explosion studies on the continents, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 412–415, 1967.

Regional coverage in explosion seismology since 1963, intensive regional studies, explosion measurements at longer ranges, new technical developments, general results, and future prospects are outlined briefly, and a bibliography of pertinent works is given.—DBV

Steinhilber, W. L. *See* Cagle, J. W. 06292

Stemmler, Rosemarie S. *See* Blyth, Colin R. 06372

Stephens, D. R. *See* Giardini, A. A. 00287

Stern, T. W. *See* Willden, Ronald. 05981

06025 **Stewart, David B.** Four-phase curve in the system $CaAl_2Si_2O_8$–SiO_2–H_2O between 1 and 10 kilobars: Schweizer. Mineralog. u. Petrog. Mitt., v. 47, no. 1, p. 35–59, illus., tables, 1967.

Experimental methods and starting materials are described. Crystalline phases are divided into anorthite, silica polymorphs, and other phases, not identified; hydrous glasses are formed also. Phase relations involved are systems: anorthite–water, quartz–water, and anorthite–quartz–water. Petrologic applications suggested include explanation of differentiation paths of magmas containing quartz and feldspar, a geobarometer for H_2O pressure, and an explanation for resorbed quartz crystals in volcanic rocks. Tables give cell dimensions of anorthite, indexed powder diffraction pattern for primitive anorthite synthesized from $CaAl_2Si_2O_8$ glass in the presence of steam, and seven experiments in the system anorthite–quartz–water used to define the liquidus and solidus at several pressures, and H_2O content of quenched glasses.—ESL

Stewart, J. D. *See* Godfrey, L. M. 00183

Stiller, Mariana. *See* Lerman, Abraham. 00213

06416 **Stöber, Werner.** Formation of silicic acid in aqueous suspensions of different silica modifications, [Chap.] 7 *in* Equilibrium concepts in natural water systems—Am.Chem.Soc., 151st Ann. Mtg., Pittsburgh, 1966, Div.Water, Air and Waste Chemistry Symposium: Washington, D.C., Am.Chem.Soc.(Adv. Chemistry Ser.67), p. 161–182, illus., table, 1967.

When fine powders of vitreous silica, quartz, tridymite, cristobalite, coesite, and stishovite of known particle-size distribution and specific surface area are investigated for their solubility in aqueous suspensions, final concentrations at and below the level of the saturated concentration of molybdate-active silicic acid are established. Experimental evidence indicates that all final concentrations are influenced by surface adsorption of silicic acid. Thus, the true solubility, in the sense of a saturated concentration of silicic acid in dynamic equilibrium with the suspended silica modification, is obscured. Regarding this solubility, the experimental final concentration represents a more or less supersaturated state. Through adsorption, the normally slow dissolution rates of silica decrease further with increasing silicic acid concentrations. Great differences exist between the dissolution rates of the individual samples.—Author's abstract

Stoiser, L. R. *See* Wells, J. D. 06274

00200 **Stoll, Ulrich W.** Foundation rebound at Dos Amigos Pumping Plant—Discussion [of paper 5439 by J. P. Bara and R. R. Hill, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 5827, Jour. Soil Mechanics and Found. Div., no. SM2, p. 614, 1968.

The writer concludes from reviewing the data in paper 5439 [ibid, v. 93, no. SM5, pt. 1, p. 153–168, 1967] that most of the apparent rebound, at this plant in the Central Valley of California, was due to hydrostatic uplift caused by artesian pressure in the alluvial soils.—ESL

00370 **Stone, Jerome.** Mineral analyses, *in* Fluvial monazite deposits in the southeastern United States: U.S. Geol. Survey Prof. Paper 568, p. 54–59, tables, 1968.

A description of the analytical techniques used, and the methods of identification of heavy minerals, is followed by tables of results. Properties of various minerals are listed and evaluated as to usefulness in determinative techniques. The methods of splitting, counting, and percentage calculation are described. The method is tested by chemical analysis and found to be valid. Spectrographic analyses and niobium tests are included also.—HRC

Stout, Perry R. *See* Hansen, R. O. 00343

Stranberg, H. D. *See* Giardini, A. A. 00287

06200 **Studer, H. P.** Mineral analysis of natural zeolite deposits [abs.], *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 187, 1967.

00291 **Studier, Martin H.; Hayatsu, Ryoichi; Anders, Edward.** Origin of organic matter in early solar system—[Pt.] 1, Hydrocarbons: Geochim. et Cosmochim. Acta, v. 32, no. 2, p. 151–173, illus., tables, 1968.

Organic compounds in Orgueil and Murray carbonaceous chondrites were examined by combination gas chromatography/mass spectrometry. Above C_{10}, normal paraffins are the principal species; below C_{10}, aliphatic hydrocarbons are markedly deficient, while benzene and alkylbenzenes dominate. A similar hydrocarbon distribution synthesized from CO and D_2 in the presence of iron meteorite powder yields a metastable distribution of normal and slightly branched paraffins and olefins. Sustained reheating causes partial transformation of aliphatics to aromatics. At 900°C, polynuclear aromatic hydrocarbons were obtained in yields of 1–8 percent. Catalytic reactions of this type may have taken place on a large scale in the solar nebula, converting CO to less volatile carbon compounds, and thus enabling carbon to condense in the inner solar system.—*from* Authors' abstract

Studier, Martin H. *See* Hayatsu, Ryoichi. 00294

06273 **Suffel, G. G.** Remobilization of Archaean massive sulphide ores, Canada [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B230, 1967.

00262 **Swain, Frederick M.** Ostracoda from the upper Tertiary Waccamaw Formation of North Carolina and South Carolina: U.S. Geol. Survey Prof. Paper 573-D, p. D1–D37, illus., tables, 1968.

The Ostracoda from 10 localities in the Waccamaw Formation are represented by 51 species. Eight species in the present collection are restricted to the Waccamaw deposits. Most of the rest of the species also occur in the closely associated upper Miocene Duplin Marl and upper part of the Yorktown Formation. An ostracode zone, typified by *Aurila conradi* (Howe and McGuirt) and *Mutilus confragosa* (Edwards) includes these three stratigraphic units and extends to the Recent. On the basis of its ostracode and associated molluscan and foraminiferal faunas, the Waccamaw Formation of North and South Carolina appears to be of transition late Miocene to early Pliocene age.—Author's abstract

06324 **Swift, Donald J. P.; Heron, S. Duncan, Jr.** Tidal deposits in the Cretaceous of the Carolina coastal plain: Sed. Geology, v. 1, no. 3, p. 259–282, illus., tables, 1967.

The Upper Cretaceous section consists of the Middendorf Formation, a fluvial sand; the marginal marine sands and clays of the Black Creek Formation; and the

uppermost Peedee Formation, a shelf sand. The Black Creek Formation is a mosaic of estuarine and lagoonal lithosomes, capped by lenses of littoral and nearshore sand; the estuarine deposits are rhythmically interstratified dark clays and pale to dark, muddy sands. Some strata sets in this lithosome coarsen downward, and become gravelly, with wood, shell, bone and clay pebble megaclasts, and closely resemble modern estuarine deposits of the Dutch coast. The nearshore lithosome consists of alternations of cross-bedded sand, mottled sand, and contorted sand with clay lamina. The Black Creek Formation is interpreted as a tide dominated sequence similar to that of the modern North Sea coast.—*from* Authors' summary

06367 **Swift, Donald J. P.; Borns, Harold W., Jr.** A raised fluviomarine outwash terrace, north shore of the Minas Basin, Nova Scotia: Jour. Geology, v. 75, no. 6, p. 693–710, illus., 1967.

The outwash terrace consists of a marine littoral and deltaic member overlain by a continental fluvial member. During deposition, the environment changed from marine to continental as rebound uplift exceeded eustatic sea-level rise. Present altitudes of the marine member above sea level show postglacial uplift to have exceeded sea level rise by at least 40 meters. Deposition occurred during retreat of the last ice sheet, which is correlated with the Port Huron recession of the midcontinent.—DRM

06409 **Swinchatt, Jonathan P.** Formation of large-scale cross-bedding in a carbonate unit: Sedimentology, v. 8, no. 2, p. 93–120, illus., tables, 1967.

The type Lindsey Bridge Member of the Mississippian Moorefield Formation in Oklahoma is composed of 24 feet of massively cross-bedded limestone. Three facies can be distinguished: (1) foresets—thick bedded, well-sorted, fine to medium crinoidal grainstone, dipping to 18°, (2) topsets—thin bedded, poorly sorted, skeletal packstones, more fossiliferous than the foresets with which they laterally grade, and which dip 5–8°, and (3) bottomsets—argillaceous, fine-grained skeletal limestones. Foresets overlie bottomsets in a typically regressive sequence. A pre-Moorefield high separated the current flow on the lower, downcurrent side. Bed load was deposited on foreset slopes and suspended load on the topset and bottomsets.—*from* Author's abstract

00283 **Sykes, Lynn R.** Deep earthquakes and rapidly-running phase changes—A reply to Dennis and Walker [1968]: Jour. Geophys. Research, v. 73, no. 4, p. 1508–1510, 1968.

Sykes (ibid., v. 71, no. 12, p. 2981–3006, 1966) did not mean to imply, as Dennis and Walker (ibid., v. 73, p. 1506–1507) state, that phase changes must be confined to zones narrowly prescribed by upper mantle structure; rather, he observed that a large number of earthquakes are confined to a rather thin distinct zone. His data do not rule out the hypothesis that deep earthquakes are caused by explosive or implosive phase changes, but they do set rather strict limits on spatial variations of the process or processes that cause deep earthquakes. There is an increasing amount of evidence that strongly supports the double-couple model of the radiation field from earthquakes. If the double-couple radiation pattern of deep earthquakes results from an explosive- or implosive-type source, some additional complication must be envisaged to generate the observed radiation field.—DBV

Syono, Y. *See* Kushiro, I. 06412

06375 **Szabo, Michael W.** Alabama's mineral industry: Alabama Geol. Survey Circ. 39, 46 p., illus., table, 1967.

Alabama's mineral wealth lies in its abundance of water; iron ore; building and construction materials such as limestone, dolomite, clay, dimension stone, sand and gravel; and fuel minerals such as petroleum and coal. The State ranks among the top 20 mineral producing states, and with proper exploration and exploitation will become more important. In 1965 the total value of raw materials produced in Alabama was about 245,000,000 dollars. Mineral producers are tabulated; locations of deposits of construction and industrial stone, major mica, barite, and graphite

deposits, oil and coal fields, and iron ore are shown on maps. Reserves for some are mentioned.—GDC

00315 **Taddeucci, Adriano; Broecker, Wallace S.; Thurber, David L.** ^{230}Th dating of volcanic rocks: Earth and Planetary Sci. Letters, v. 3, no. 4, p. 338–342, tables, 1967 [1968].

Measurements of U–238, Th–232, and Th–230 have been made in separated phases from four of the Mono Craters volcanics and from one of the Inyo Craters. The results show that sufficiently large differences in U–Th ratio exist between the glass and the hornblende separates to allow dating of these eruptions. Suggested ages for the Mono Craters range between 2,000 and 10,000 years, and show a general agreement with K–Ar ages and the geological evidence. The Inyo Crater sample has an apparent age of 35,000 years, ten times higher than the K–Ar age.—Authors' abstract

Tailleur, Irwin L. *See* Tourtelot, Harry A. 06261

05985 **Takeda, Hiroshi; Donnay, J. D. H.; Roseboom, Eugene H.; Appleman, Daniel E.** The crystallography of djurleite, $Cu_{1.97}S$ [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 404–413, tables, 1967.

Djurleite is a valid species, orthorhombic or pseudo-orthorhombic, with composition $Cu_{1.97}S$, diffraction aspect P^*n^*, and cell dimensions: $a = 26.92$ Å, $b = 15.71$, $c = 13.56$, all $\pm$ 0.2 percent. For $Z = 128$, or $Cu_{252}S_{128}$ per cell, $D_x = 5.81$ g cm^{-3}; $D_m = 5.747 \pm 0.007$. Single crystals are rare. A strongly marked pseudo-hexagonal subcell has an intensity distribution reflecting the hexagonal close-packed arrangement of the sulfur atoms.—Authors' abstract

06008 **Takeda, Hiroshi; Donnay, J. D. H.; Appleman, Daniel E.** Djurleite twinning [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 414–422, illus., 1967.

Djurleite has been found twinned according to two different laws. Pseudo-hexagonal twins, frequent, are ideally composed of three crystals around [100]. Rare pseudo-tetragonal twins are idealized as two crystals 90° apart around [010]. Both types of twinning are explained by the hexagonal close-packed arrangement of sulfur atoms, controlled by a structural sublattice: $a/4$, $b/4$, $c/2$.—Authors' abstract

Tanaka, Y. *See* Ashida, K. 06161

06040 **Tanner, William F.** Ripple mark indices and their uses: Sedimentology, v. 9, no. 2, p. 88–104, illus., 1967.

Seven dimensionless parameters for ripple mark geometry determination are: ripple index RI, symmetry index RSI, continuity index CI, bifurcation index BI, straightness index SI, and two different parallelism indices PI_1 and PI_2. Certain values in certain indices identify origin of ripple mark. RI plotted against RSI is particularly useful, as is RI plotted against PI_1. When all seven parameters are obtained, confidence can be 98 percent. Wave type ripple marks cannot be used to determine direction of wave energy or sediment transport unless there is no, or very little, RSI bias (1.0). Even if RSI = 1.0, transport direction still cannot be determined. The RI can be used to distinguish between various types of swash-zone ripple marks.—*from* Author's summary

06154 **Tanner, William F.** Calculation of coastal energy and drift rate [with French abs.], Paper S34 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 4, Pt. 2, Seminar communications: Fort Collins, Colo., Colorado State Univ., p. 313–317; discussion, ibid., V. 5, p. 637, 1967.

In the first of two calculations, an exponential equation relates shelf slope (distance from a critical depth to the shore) to wave energy (breaker height), the dependent variable. The coefficient on the exponent, and the initial conditions, are obtained from published data; the fit for certain coasts in the southeastern United States is good. In the second calculation, depletion-accumulation rates on a Florida spit

of apparently known dimensions and age are converted into work figures and then compared with results from two other similar bodies. The critical distances, in the cases studied, average about 5 km for an inferred history of 4,000 years. An impulse determination yields about the same results. For the areas studied, available wave energy appears to be about 10^6 times the energy spent in unidirectional littoral sediment transport.—*from* Author's abstract

Tatlock, Donald B. *See* Wones, David R. 06027

06313 **Taylor, F. C.** Geology, Shelburne area, Nova Scotia: Canada Geol. Survey Map 1186A (also in Mem. 349), scale 1:126,720, 1967.

06318 **Taylor, F. C.** Reconnaissance geology of Shelburne map-area, Queens, Shelburne, and Yarmouth counties, Nova Scotia [with French abs.]: Canada Geol. Survey Mem. 349, 83 p., illus., tables, geol. map, 1967.

Most of the map-area is underlain by the Ordovician Meguma Group of two formations: the Goldenville, largely graywacke and conglomerate, overlain by thinly laminated slates of the Halifax. Both are regionally metamorphosed to almandine amphibolite facies in the eastern two-thirds, greenschist in the remainder. In the Yarmouth syncline, the White Rock Formation (post-Lower Ordovician and pre-Upper Silurian) conformably overlies the Halifax, and is more than 15,500 feet thick. During Devonian, layered rocks were intruded by several granitic plutons. Basic intrusions, both pre- and post-granitic, occur locally. North- to northeast-trending folds formed during the Acadian orogeny; few faults are known. Pleistocene ice moved south-southeastward. Drowned forests along the coast show recent sea encroachment. Building stone is the only economic mineral.—*from* Author's abstract

06233 **Taylor, R. E.; Berger, Rainer.** Radiocarbon content of marine shells from the Pacific coasts of Central and South America: Science, v. 158, no. 3805, p. 1180-1182, illus., table, 1967.

The radiocarbon content of contemporary pre-bomb marine shells from the region of upwelling of the Pacific coast of South America has been determined and found to be somewhat similar to the content of shells from the coast of California and the west coast of Mexico. Deviations of up to −8.5 percent with reference to the contemporary biospheric C-14 standard have been observed for the Peruvian coast. Values of from −0.35 to −4.04 percent have been obtained for marine shells from the Galápagos group. Problems associated with radiocarbon dates based on shells are discussed.—Authors' abstract

Tedrow, J. C. F. *See* Rickert, D. A. 06175

00360 **Texas Water Development Board.** Texas Water Development Board list of publications: Texas Water Devel. Board Circ. 3, 52 p., illus., 1968.

In September 1965, the Texas Water Development Board succeeded the Texas Water Commission (before February 1962, the State Board of Water Engineers). This circular lists only those publications held and distributed by the present board, which includes (1) bulletins, circulars, memorandum reports, limited-distribution reports, and water resources planning reports formerly printed and distributed by its predecessors, and (2) the three series of the present organization—reports, circulars, and a planning series. A county and river basin location map aids in determining which reports pertain to particular subjects and areas.—MCM

Theobald, Paul K., Jr. *See* Overstreet, William C. 00323

00324 **Thiers, Gerald R.; Seed, H. Bolton.** Cyclic stress-strain characteristics of clay: Am. Soc. Civil Engineers Proc., v. 94, paper 5871, Jour. Soil Mechanics and Found. Div., no. SM2, p. 555-569, illus., 1968.

Decrease in moduli and increases in yield strain occurring during cyclic loading of sensitive clay under simple shear conditions are examined. Loading conditions are representative of those associated with upward propagation of a seismic shear

through a large mass of soil—strain is completely reversed during each cycle at the rate of 1 cps. Moduli and yield strain reported are those defining bilinear hysteresis models which best fit nonlinear stress–strain characteristics obtained from the tests. For San Francisco Bay mud the moduli are constant for strain levels greater than 2 percent and for loading cycles after the fiftieth. Yield strain is proportional to cyclic strain level for at least 200 cycles. Strength and moduli measured under static loading conditions are decreased by cyclic loading involving large strains, but only the modulus is decreased by loading restricted to strains below about 1 percent.—*from* Authors' abstract

Thode, H. G. *See* Kemp, A. L. W. 00270

Thomas, Herman H. *See* Willden, Ronald. 05981

Thüna, P. C. von. *See* Aronson, J. R. 06366

Thurber, David L. *See* Broecker, Wallace S. 00211

Thurber, David L. *See* Taddeucci, Adriano. 00315

00340 **Thurston, William.** The first International Geological Congress: Geotimes, v. 13, no. 2, p. 16–17, 1968.

In 1876 at the fall meeting of the Am. Assoc. Petroleum Geologists in Buffalo, N.Y., a committee was formed of eight North American geologists, Huxley of England, Torell of Sweden, and Baumhauer of the Netherlands, to consider how to organize an international gathering. The forthcoming Paris Exposition of 1878 seemed an auspicious occasion, and the Geological Society of France rose to the challenge by forming an Organizing Committee, and then a Council of 85 which included the founding committee from America. Thus the basic pattern of the International Geological Congress was established in Paris, where about 325 geologists registered and three dozen papers were presented. The complete proceedings were published in one volume of 313 pages.—GDC

Tilles, David. *See* Parkin, David W. 00176

Titus, Frank B., Jr. *See* Ballance, W. C. 06439

06441 **Titus, Frank B., Jr.** Central closed basins—Geography, geology, and hydrology, *in* Water resources of New Mexico (New Mexico State Engineer Office, compiler): Santa Fe, N. Mex., State Plan. Office, p. 97–111, illus., tables, 1967.

In this Basin and Range region four basins are described: Estancia, Jornada del Muerto, Tularosa, and the sparsely populated Salt basin. A few perennial streams in the high mountains disappear quickly at their base; numerous playas lie in central parts of the basins, largely underlain by Quaternary bolson deposits. In the centers of all but the Jornada basin are lacustrine sediments with secondary gypsum which affects the ground water; the surrounding alluvium is poorly sorted. Older rock formations of all ages are exposed in mountain areas and protrude bolson deposits here and there; except for prolific Permian aquifers, they yield only little water of variable quality. Extrusive igneous rocks constitute important parts of Cenozoic sequences. A generalized stratigraphic section summarizes the units, their distribution, properties, and aquifer characteristics. The bolson alluvium is the most reliable source of water.—GDC

06262 **Tixier, M. P.; Curtis, M. R.** Oil shale yield predicted from well logs [with French and Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 713–715, illus., 1967.

Well logs permit in situ evaluation of oil shales. Density logs, in particular, exhibit close correlation with assay yields determined using the modified Fischer retort method. Study of a 300 ft section of oil shale in the Piceance Basin, Colorado, indicates that density log values are related to assay yield by the equation: Yield

in gallons per ton = 154.81 – 59.43 × Density, in g/cc (given by the log).—Authors' abstract

00338 **Todd, Ruth.** Recent literature on the Foraminifera: Cushman Found. Foram. Research Contr., v. 19, pt. 1, p. 33–39, 1968.

There are eighty annotated entries from all over the world, including North America.—HRC

06172 **Toebes, G. H.; Chang, Ting P.** Planform analysis of meandering rivers [with French abs.], Paper A45 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 362–369, illus.; discussion, ibid., V. 5, p. 139–140, 150–151, 1967.

Search for simple deterministic equilibrium relations in meander planforms, similar in widely varying rivers, may be futile; complementary statistical studies have given special attention to time series analysis. A spectral analysis of planforms, in the well-meandered White River system of Indiana, shows within the smaller upstream reaches a randomness of peaks or wide variety of wave lengths or both. Trends are illustrated in amplitude contours on intensity maps. Application of spectral analysis to actual coordinate traces of river centerlines will require cross-correlation of local planform with local nonstationary data, and trend removal. The detail obtained is of value but such studies are costly; river changes with time cannot be neglected for the long reaches.—GDC

00174 **Toksöz, M. Nafi; Lacoss, Richard T.** Microseisms—Mode structure and sources: Science, v. 159, no. 3817, p. 872–873, illus., table, 1968.

Frequency-wave number spectra of microseisms were obtained by use of a set of short period and long period seismometers at LASA (Large Aperture Seismic Array, Montana). At times of relatively high microseismic activity short-period (shorter than 5 seconds) microseisms consist of both body waves and higher-mode surface waves. From the phase velocity and direction of body waves, source areas were determined, coinciding with low-pressure regions on the weather map. At longer periods, microseisms consist of fundamental mode Rayleigh and Love waves, the former being dominant. Most microseismic energy arrives at LASA from the northeast and the west.—Authors' abstract

06261 **Tourtelot, Harry A.; Donnell, John R.; Tailleur, Irwin L.** Oil yield and chemical composition of shale from northern Alaska [with French and Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 707–711, tables, 1967.

Oil shale with yields up to 150 gal per ton occurs in a complexly folded rock sequence of Late Jurassic to Early Cretaceous age for several hundred miles along the north flank of the Brooks Range in Alaska. Data are given on oil yield and organic and metallic element composition of samples from the principal types of oil shale: tasmanites, a peculiar rubbery shaly coal, a cannel coal, an impure coal of different nature, and a black shale.—VSN

06407 **Trauger, Frederick D.** Lower Colorado River basin—Geography, geology, and hydrology, *in* Water resources of New Mexico (New Mexico State Engineer Office, compiler): Santa Fe, N. Mex., State Plan. Office, p. 211–229, illus., tables, 1967.

On the western border of New Mexico are four sub-basins of the Lower Colorado River. The geomorphology and structure are complicated by juxtaposition of elevated Colorado Plateaus and complexly faulted Basin and Range lands. Rocks varying in age from Precambrian to Recent include metamorphic, intrusive and volcanic igneous rocks, marine sediments and continental deposits. A generalized stratigraphic section summarizes unit distributions and properties, and designates aquifers; valley alluvium and deeper bolson fill in San Simon Valley are the most important and extensive aquifers, and yield good water. Bedrock under bolson fill is largely unexplored for water.—GDC

Trauger, Frederick D. *See* Cooper, James B. 06432

06244 **Trettin, H. P.; Hills, L. V.** Triassic "Tar Sands" of Melville Island, Canadian Arctic Archipelago [with French and Spanish abs.], *in* Drilling and production—World Petroleum Cong., 7th, Mexico, 1967, Proc., V. 3: London, Elsevier Publishing Co., p. 773–787, illus., 1967.

Bitumen deposits, discovered in the Bjorne Formation of Melville Island in 1962, are the first reported major showing of petroleum in the Arctic Archipelago. The Bjorne Formation, the Lower Triassic marginal facies of the Sverdrup Basin, here forms a homocline dipping gently into the basin, and represents a fan-shaped prograding delta. Outcrops suggest that between 50 to 100 M M brl of asphaltic oil are present with only 30 M M brl in concentrations about 6 percent by weight. The oil occurs in sandstones and conglomerates in the upper part of the formation beneath a disconformable Jurassic seal. Geologic evidence and sulfur isotope determinations suggest it originated in Pennsylvanian to Jurassic beds and migrated updip in Middle Jurassic or later time.—*from* Authors' abstract

06076 **Tricart, J.** Delta lagunaire (rio Parita, Azuero) [also English and Spanish texts]: Photo Interprétation 67-3, pt. 1, p. 1–7, illus., 1967.

A stereoscopic triplet with interpretive overlay is given for the area on the Azuera Peninsula, Panama, where the Rio Parita empties into the Gulf of Parita. A lagoon was formed here and then filled in by the delta. Geomorphic evolution followed three steps: deposit of a sandy-silty spread which dips under the lagoon; construction of littoral cordons during transgression, covering the lower part of the spread and indicating recent subsidence; and deposition of a Dunkerquian cordon, farther out, making the bay into a lagoon. Seven accumulation shapes on the delta inside this lagoon include alluvial overflow banks with sheet overflow at their foot, recent littoral deposits, and eolian activity on the cordon.—ESL

06077 **Tricart, J.** Rapports entre le milieu physique et la géographie agraire (cours inférieur du rio La Villa, SE de Chitré, Panama) [also English and Spanish texts]: Photo Interprétation 67-3, pt. 2, p. 8–14, illus., 1967.

A stereoscopic triplet with interpretive overlay covers an alluvial plain at the foot of volcanic hills rising from the Azuera Peninsula. Four elements that can be distinguished are: an old flow, sloping ENE, and disappearing under the coastal area; the alluvial banks of the Rio La Villa; a former littoral cordon covering the lower end of the flow; and a former lagoon, closed in the east by the cordon, and now operating as a sedimentation basin. Land use is closely adapted to this environment.—ESL

06078 **Tricart, J.** Épandage hydrovolcanique quaternaire au pied du volcan Baru, au bord du rio Escarrea (Panama) [also English and Spanish texts]: Photo Interprétation 67-3, pt. 3, p. 15–21, illus., 1967.

The area covered by this stereoscopic triplet and interpretative overlay is at the foot of the Baru Volcano in a depressed area on the edge of the Pacific. Large sheets of pyroclastic products have been deposited by violent floods set off by eruptions. The volcano has several successive explosion craters which are fresh enough to be Quaternary. Deposits of four ages can be seen: an ancient deposit, with the original relief weathered away, is fossilized under more recent deposits; a recent deposit, spread out in a fan showing anastomosing channels; a very recent accumulation showing fresh microrelief; and the present major channel, enclosed between terraces upstream and following the main channels of the recent accumulation downstream. The catastrophic floods were accompanied by tectonic warping which caused the upstream area to rise and the downstream to sink.—ESL

06427 **Triplehorn, D. M.** Morphology, internal structure, and origin of glauconite pellets—A reply [to discussion by J. Konta of 1966 paper]: Sedimentology, v. 8, no. 2, p. 170–171, 1967.

In a reply to J. Konta's discussion (ibid., p. 169–170), there appears to be agreeable acceptance of suggestions.—HRC

06357 **Troxel, Bennie W.** Sedimentary rocks of late Precambrian and Cambrian age in the southern Salt Spring Hills, southeastern Death Valley, California, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 92, p. 33–41, illus., geol. map, 1967.

Part of a 3,600-ft section of the Kingston Peak Formation here appears to be glacial-marine strata. The overlying Johnnie Formation and Stirling Quartzite of late Precambrian age and the Wood Canyon Formation and Zabriskie Quartzite of Cambrian age are marine strata 3,400 feet thick. The same post-Kingston Peak units in the Nopah Range, 25 miles to the northeast, total 7,500 feet. Other rocks in the southern Salt Spring Hills include intrusive Mesozoic(?) quartz monzonite, Quaternary fan deposits, and a small Pleistocene(?) playa. Several faults cut the rocks in Tertiary(?) time after the strata were folded into a shallow NE-trending syncline.—GDC

06003 **Trüper, Hans G.; Hathaway, John C.** Orthorhombic sulphur formed by photosynthetic sulphur bacteria: Nature, v. 215, no. 5099, p. 435–436, illus., 1967.

It is shown that despite the different metabolic roles of sulfur in colorless and in photosynthetic sulfur bacteria, the sulfur formed by the latter is also orthorhombic; this confirms Starkey's (1935, 1937) statement that "there is no evidence that the globules produced by the larger colorless sulfur bacteria, by the purple (and green) bacteria, or by *Thiobacillus thioparus* differ chemically."—DBV

00185 **Tucker, L. R.** Geophysical activity in 1966 applied to engineering, construction, and groundwater projects: Geophysics, v. 33, no. 1, p. 137–141, tables, 1968.

This is a survey of geophysical activity in 1966 as applied to ground water, engineering, and construction projects, based on a special questionnaire developed for the purpose.—DBV

06414 **Turekian, Karl K.; Scott, Martha R.** Concentrations of Cr, Ag, Mo, Ni, Co, and Mn in suspended material in streams: Environmental Sci. and Technology, v. 1, no. 11, p. 940–942, illus., tables, 1967.

There are regional differences in the concentrations of chromium, silver, molybdenum, nickel, cobalt, and manganese in suspended sediments of streams. The sediments of the Mississippi, and the rivers west of it draining into the Gulf of Mexico, as well as the Rhone River resemble average shale in composition, while the rivers of the United States east of the Mississippi are considerably higher in concentration. This difference is not due to differences in cation-exchange capacity but rather perhaps to a greater amount of a trace-element rich soil component and industrial contamination in the eastern rivers. The Susquehanna River alone is supplying about 45 tons of silver a year as possible recoverable detrital material.—Authors' abstract

06183 **Turner, R. C.; Brydon, J. E.** Removal of interlayer aluminum hydroxide from montmorillonite by seeding the suspension with gibbsite: Soil Sci., v. 104, no. 5, p. 332–335, illus., 1967.

Seeding a suspension of an aluminum hydroxide and montmorillonite (Wyoming bentonite) with synthetic gibbsite was found to cause the interlayer aluminum hydroxide to recrystallize to gibbsite in a period of ten months.—JWH

06146 **Uchupi, Elazar; Jones, Gilbert F.** Woody debris on the mainland shelf off Ventura, southern California: Sedimentology, v. 8, no. 2, p. 147–151, illus., 1967.

Land plant debris occurs in appreciable quantities in the shelf sediments off Ventura, southern California. Concentrations range from less than 2 g (wet weight)/l (less than 250 g/m^2) to 53 g (10,662 gl/m^2). The highest values are found near the outer edge of the shelf.—Authors' summary

Ulrych, T. J. *See* Russell, R. D. 00372

06181 **Ursic, S. J.** Improved standards for neutron soil water meters: Soil Sci., v. 104, no. 5, p. 323–325, 1967.

Economical standards made from polyethylene cylinders 2.5 and 4.5 inches in diameter proved highly satisfactory for operational checks and recalibration of neutron soil water probe systems. They were used in conjunction with laboratory calibrations by the water-addition technique.—*from* Author's summary

06276 **U.S. Army Corps Engineers.** Survey report on Licking River Basin, Ohio—V. 3, App. E, Geology and soils: Huntington, W. Va., U.S. Army Corps Engineers, Huntington District, p. E1–E5, illus., 1967.

The Utica dam site and reservoir area, investigated here, is in the Till Plains section of the Central Lowlands physiographic province, with nearby plateau elevations of 850 to 1,400 feet. Twice glaciated during the Pleistocene epoch, the area is thickly mantled with till and outwash, beneath which are remnant ridges of an ancient bedrock plateau surface. Deeply buried valleys filled with granular soils characterize the Till Plains drainage system. Shallow bedrock encountered in the abutment borings is weathered sandstone of the Logan Formation with thin shale interbeds. The buried gorge may be quite steep and U-shaped. Seepage under the dam through the granular layers may be significant, that from the reservoir rim no problem. A soils and geology legend, profiles and sections, and logs of borings are included.—GDC

00356 **U.S. Geological Survey.** U.S. Geological Survey Heavy Metals program progress report, 1966 and 1967: U.S. Geol. Survey Circ. 560, 24 p., 1968.

The Heavy Metals program is a joint effort by the Geological Survey and the Bureau of Mines to stimulate domestic production of metals in short supply. Significant results through 1967 are: discovery of over 3 million tons of ore averaging 0.3 ounce gold per ton near Cortez, Nev.; samples from area near Cripple Creek, Colo., average 2.5 dollars per ton gold and indicate a potentially large low-grade deposit; conglomerates in northwestern Wyoming contain 6–35 cents in gold per cu yd of rock, with possibility of finding higher grade concentrations; anomalously large amounts of gold, silver, tellurium, and mercury found in rocks around copper deposits of the Ely, Nev., district; large deposits of barite in east Northumberland Canyon, Nye County, Nev.; and development of a mercury-vapor detector, capable of analyzing 60–100 samples per day for mercury in concentrations as low as 5 ppb.—MCM

U.S. Geological Survey. *See* New Mexico State Engineer Office, 06442

00286 **VanAndel, Tjeerd H.; Bowin, Carl O.** Mid-Atlantic Ridge between 22° and 23° north latitude and the tectonics of mid-ocean rises: Jour. Geophys. Research, v. 73, no. 4, p. 1279–1298, illus., 1968.

A detailed geological and geophysical study of the crest and upper western flank of the mid-Atlantic ridge between lat 22° and 23° N. and long 44° to 46° W. reveals the following: (1) different physiographic zones parallel the ridge axis but only the crest shows strong topographic linearity, (2) metamorphosed basalts indicate regional metamorphism of the lower part of a gradually thickening crust, followed by uplift and tectonic displacement of the overburden, (3) relief of the upper flank is Late Miocene and crestal relief is Quaternary, (4) small free-air gravity anomalies indicate that the ridge is nearly in isostatic equilibrium, and (5) magnetic profiles interpreted by the sea-floor spreading hypothesis give a spreading rate of 1.4 cm per yr for the crestal part of the ridge. Topographic differences between the mid-Atlantic Ridge and other rises, and their causes, are discussed.—KAS

00275 **VanDiver, Bradford B.** Origin of Jove Peak Orbiculite in Wenatchee Ridge area, northern Cascades, Washington: Am. Jour. Sci., v. 266, no. 2, p. 110–123, illus., 1968.

The sill-like, metagabbroic Jove Peak Orbiculite intruded the Chiwaukum Schist during the Skagit metamorphism, and was later intruded by quartz diorite. Orbicules of hornblende nucleated on pyroxene or hornblende phenocrysts, or on xenoliths

of gabbro, hornblendite(?), pyroxenite(?), mica schist, and amphibolite. The igneous origin of the orbicules is shown, and other characteristics clearly indicate post-orbicular recrystallization. The orbiculite matrix contains abundant relict igneous features. Subsequent medium-grade metamorphism is shown. This dual igneous-metamorphic origin (as opposed to migmatitic) is also shown by bimodal plagioclase composition and by remarkable compositional differences in plagioclase across interfingering mica schist-orbiculite contact.—*from* Author's abstract

00351 **VanLopik, Jack.** Infrared mapping—Basic technology and geoscience applications: GeoScience News, v. 1, no. 3, p. 4–7, 24–31, 36, illus., 1968.

The infrared region of the electromagnetic spectrum extends from 0.72 microns to about 1,000 microns. Advantages and dye layers are described of two types of aerial film that are sensitive to radiation in the near-infrared spectrum. Topics discussed under infrared imagery are: atmospheric effects, basic physics, infrared sensing systems, and applications. Under the last, the geothermal gradient, internal heat and its conductivity, soil mapping by radiometric temperatures and reflectance levels, and surveys for hydrographic purposes are examined. Optimum approach to most geoscience investigations involves a combination of infrared and other aerial or ground techniques; a specific sensor specific problem approach can result in identification of the best combination.—ESL

06219 **VanNess, G. B.** Geologic implications of anthrax, *in* Relation of geology and trace elements to nutrition—A symposium, New York, 1963: Geol. Soc. America Spec. Paper 90, p. 61–64, illus., 1967.

The distribution of anthrax has been shown to be geologically controlled for it is associated with limestone soils, alkaline alluvial soils, and clay soils where there is a hardpan layer. The development of spore formation of *Bacillus anthracis* requires a pH of more than 6 and a minimum temperature of 60°F.—Author's abstract

vanOlphen, H. *See* Andrews, Donald E. 06188

vanOlphen, H. *See* Deeds, C. T. 06223

06180 **VanWambeke, A.** Recent developments in the classification of the soils of the tropics: Soil Sci., v. 104, no. 5, p. 309–313, 1967.

Genetic sequences of profiles of tropical climates from young to mature soils will pass through different orders, eventually including entisols, inceptisols, ultisols, and oxisols. This sequence reflects more advancing weathering than climatic influences. Thus, small scale maps will have to take into account geomorphic and geologic data, more than prevailing climate.—*from* Author's summary

Vogel, J. C. *See* Mook, W. G. 00173

Vondra, Carl F. *See* Schultz, C. Bertrand, 06033

vonLimbach, Dora. *See* Wones, David R. 06027

06153 **Vreugdenhil, C. B.; deVries, Mattheus.** Computations of non steady bedload transport by a pseudo viscosity method [with French abs.], Papr C35 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 3: Fort Collins, Colo., Colorado State Univ., p. 303–313, illus., 1967.

The behaviour of the bottom level of an alluvial channel with fixed banks is studied with regard to the change of the hydraulic conditions. Special attention has been paid to the numerical procedure; the application of a difference scheme according to Lax is proposed. For some examples the comparison between measurements and computations has been made. Some computations are compared with those obtained by the more cumbersome method of characteristics.—Authors' summary

06364 **Wagener, K.** Tritium loss from iron meteorites by solar wind hydrogen: Zeitschr. Naturforschung, v. 22a, no. 10, p. 1483–1488, illus., table, 1967.

An estimate of the diffusion loss of tritium from iron meteorites in space cannot be based directly on the results of laboratory diffusion measurements, because the hydrogen content of laboratory samples is always many orders of magnitude higher than the cosmic-ray-produced tritium of iron meteorites. Meteoritic iron in space may not only contain hydrogen isotopes derived from cosmic ray-produced spallation processes, but also that derived from solar wind bombardment. The steady-state hydrogen content of an iron meteorite, resulting from bombardment in space, depends on the size and structure of the meteorite body. Only meteorites consisting of grains larger than several millimeters retain cosmogenic tritium at temperatures close to 0°C, or higher.—KAS

00366 **Wager, L. R.; Brown, G. M.** Layered igneous rocks: Edinburgh and London, Oliver and Boyd, 588 p., illus., tables, geol. map, 1968.

The petrogenetic process of crystal fractionation in magmas is interpreted in this study of layered intrusions. The first half constitutes a synthesis and extensive revision of work since 1935 on the Skaergaard intrusion, a plutonic complex in East Greenland produced by a single emplacement of olivine gabbro magma; minerals, layered series and border groups, geochemistry, mechanism of differentiation, and fractionation trend are treated. In the second half, Rhum ultrabasic complex, Scotland, Bushveld intrusion, South Africa, and Stillwater basic-ultrabasic intrusion, Montana, are described at length, and many others are described briefly. Generalizations on layered intrusions are presented, with explanation of rhythmic (gravity) and cryptic (chemical) layering and conditions for differentiation in major layered intrusions as distinguished from those in minor intrusions.—VMJ

Walker, C. Trevor. *See* Dennis, John G. 00284

Walker, R. M. *See* Fleischer, R. L. 00298

Walton, E. K. *See* Oertel, G. 06041

Wampler, J. M. *See* Pecuil, T. E. 06112

06369 **Wangersky, Peter J.** Removal of soluble salts from air dried sediments: Jour. Geology, v. 75, no. 6, p. 733–735, tables, 1967.

Suspension of air-dried sediments in distilled water resulted in the removal of magnesium and calcium in amounts differing from those originally present in the interstitial water. Excess calcium was put into solution, while a large proportion of the magnesium originally present in the interstitial water was not redissolved. It cannot be assumed that washing with distilled water renders sedimentary material "salt free."—Author's abstract

Warkentin, B. P. *See* Hamid, A. 06178

Warman, James C. *See* Joiner, Thomas J. 06376

06132 **Warner, D. L.; Doty, L. F.** Chemical reaction between recharge water and aquifer water [with French abs.], *in* Artificial recharge and management of aquifers—Symposium of Haifa, 1967: Internat. Assoc. Sci. Hydrology Pub. 72, p. 278–288, illus., table, 1967.

Chemical reaction between recharge water and aquifer water may influence water quality and aquifer permeability, and may cause fouling in discharge wells. However, evidence suggests that the danger of permeability reduction may not be very great. Precipitates of calcium and magnesium carbonate and iron compounds are the most likely reaction products. The amount and distribution of reactive chemicals remaining in solution can be related to the dispersive characteristics of a porous medium. Reactions of various rates are considered. It may be desirable to prevent reaction. It is suggested that, in some cases, this can be accomplished by emplacing a buffer zone of nonreactive water between the recharge water and the aquifer water.—Authors' abstract

06212 **Warren, Harry V.; Delavault, Robert E.** Possible correlations between geology and epidemiology [abs.], *in* Relation of geology and trace elements to nutrition—A symposium, New York, 1963: Geol. Soc. America Spec. Paper 90, p. 5, 1967.

Wasserburg, G. J. *See* Bogard, D. 00314

00329 **Waters, J. N.** Eocene faunule from the basal San Juan Bautista Formation of California: Cushman Found. Foram. Research Contr., v. 19, pt. 1, p. 18–20, illus., 1968.

The San Juan Bautista formation, until now unyielding of microfossils, has been considered to be of Oligocene age on the basis of megafossils. A small, poorly preserved foraminiferal faunule indicates a middle Eocene age for the basal part of the formation.—Author's abstract

06302 **Waugh, Harry; Macdonald, Frank.** Deep ocean seismic recording, *in* The new thrust seaward—MTS Conf. and Exhibit, 3d Ann., San Diego, Calif., 1967, Trans.: Washington, D. C., Marine Technology Soc., p. 127–146, illus., 1967.

Operation of seismic profilers in conditions approaching 10 knots requires a seismic data acquisition system which minimizes signal noise ratio degradation for adverse conditions. Significant features of a successful system which improves signal-to-noise ratio and increases interpretive value of the data are: a receiving array designed to minimize boat generated noise and off axis ambient noise components; a programmable ten-track magnetic drum additive compositor; a gain control system incorporating automatic gain control, fixed gain, pre suppression for AGC, and program gain control; and separate amplifiers/filters which provide for high resolution (20–2000 cps) recording on an 11 in. recorder and maximum penetration (20–500 cps) on a 19 in. recorder.—*from* Authors' abstract

Weaver, C. E. *See* Pecuil, T. E. 06112

06234 **Weaver, E. A.** Vapor phase growth of ZnO single crystals: Jour. Crystal Growth, v. 1, no. 5, p. 320–322, illus., 1967.

Zincite, ZnO, crystals have been grown by the vapor phase reaction of $ZnCl_2$ with H_2O. The growth tube was in a vertical position and placed inside the furnace chamber used to volatilize the zinc chloride. Three growth-zone temperature ranges were studied: 500–650°C; 700–800°C; and 1050°C. Color, crystal form, and resistivity are described.—ESL

00172 **Webb, Gregory W.** Palinspastic restoration suggesting late Paleozoic North Atlantic rifting: Science, v. 159, no. 3817, p. 875–878, illus., 1968.

Palinspastic restoration of sinistral wrench faults in Britain and of dextral wrenches in Canada, starting with the palinspastic precontinental-drift map, implies the possibility of as much as 424 km of rifting between Newfoundland and Ireland. The wrench faulting and postulated resultant rifting are of Devonian and Carboniferous age.—Author's abstract

Weber, Ernest M. *See* Chun, Robert Y. D. 06106

00299 **Weber, Jon N.** Fractionation of the stable isotopes of carbon and oxygen in calcareous marine invertebrates—The Asteroidea, Ophiuroidea and Crinoidea: Geochim. et Cosmochim. Acta, v. 32, no. 1, p. 33–70, illus., tables, 1968.

Analysis of 573 living asteroids indicates that (1) relatively large and systematic variations in values of δC^{-13} and δO^{-18} which occur for different skeletal elements within a single animal are positively correlated, (2) asteroid calcite is enriched in C^{-12} and O^{-16} with respect to "inorganic" carbonate, and (3) significant differences in isotopic composition exist at the species and higher levels. Analysis of 166 ophiuroids shows systematic differences within a single animal in δC^{-13} and δO^{-18} for different positively but poorly correlated skeletal elements. Skeletal calcite of living crinoids is appreciably enriched in C^{-12} and moderately enriched in O^{-16}. Crinoidal calcites are isotopically lighter than those of most other echinoderms,

and the fractionation model proposed for echinoids, ophiuroids, and asteroids applies equally well to crinoids.—KAS

Webster, Jacqueline. *See* Schlee, John. 06430

Weed, S. B. *See* Leonard, R. A. 06108

06184 **Weed, S. B.; Leonard, R. A.** Variations in properties within single flakes of hydrobiotite-vermiculite: Soil Sci., v. 104, no. 6, p. 416–421, illus., tables, 1967.

Individual flakes of vermiculite exhibited two different basal spacings by X-ray diffraction. One combination of basal spacings occurred when hydrobiotite predominated around the flake edges and vermiculite predominated in the center. The other combination of basal spacings occurred when vermiculite predominated around the flake edges and hydrobiotite predominated in the center. The hydrobiotite phase in the first combination may have developed by K^+ entry into vermiculite rather than K^+ removal from the center of a trioctahedral mica.—JWH

Weiblen, Paul W. *See* Ross, Malcolm. 00177

00322 **Weigle, James M.** Ground-water resources of the lower Merrimack River valley, south-central New Hampshire: U.S. Geol. Survey Hydrol. Inv. Atlas HA-277, scale 1:62,500, text, 1968.

Bedrock and an overlying discontinuous mantle of glacial till occur at or near land surface in most of the hilly upland area and are buried under stratified glacial drift deposits in valleys and plains of the lower Merrimack River valley. Bedrock and glacial till are sources of small supplies of ground water but ice-contact and outwash deposits are a more favorable source for larger supplies. Bedrock wells generally yield less than 10 or 15 gpm, except in a unique area (Salem, Pelham, and Atkinson) where yields vary from 40–150 gpm; source is probably a fault zone. Areas most suitable for development of large-scale supplies are those underlain by the stratified glacial drift.—MCM

Welday, E. E. *See* Baird, A. K. 06389

06274 **Wells, J. D.; Stoiser, L. R.; Erickson, R. L.** Geology and mineralogy of the Cortez gold prospect, Nevada [abs.]: Inst. Mining and Metallurgy Trans., v. 76, sec. B, Bull. 732, p. B232, 1967.

Wells, J. S. *See* Anderson, K. H. 00265

00339 **Westermann, G. E. G.** North American paleontologists in 1967: Geotimes, v. 13, no. 2, p. 14–15, illus., 1968.

Some of the most interesting statistics resulting from compilation of data for the Directory of Palaeontologists of the World (2d edition, to be published in 1968) are presented here in graphic form. An exception to the usual distribution correlation with population density is the large number of paleontologists concerned with Alaska and the Canadian Arctic. Some North American paleontologists also specialize in areas outside this continent. Major specialties are indicated in pie diagrams, by discipline, by geologic time, and by taxon. That a surprising 40 percent interest in the Cenozoic is not evident in published materials may reflect the partly classified character of research in oil companies. About 500 institutions in North America employ paleontologists; these will be listed in the complete directory.—GDC

Weyant, Marcel. *See* Rioult, Michel. 06361

06022 **Weyl, R.** Die paläogeographische Entwicklung des mittelamerikanischen Raumes: Deutsch. Geol. Gesell. Zeitschr. 1964, v. 116, no. 3, p. 578–583, illus., 1967.

The paleogeographic development of continental Central America can be traced back to late Paleozoic time, and that of the Caribbean area from Jurassic time. Opinions

concerning the continental or marine environment of the latter area during the Cretaceous differ widely. Among the evidence advanced for the existence of a Caribbean continent are the necessity of large source areas for the thick Cayetano beds in Cuba and Cretaceous shales of Jamaica, remains of a continental crust in the Nicaragua ridge between regions of oceanic crust, the position of the Antilles geosynclines, and the magmatic characteristics of the Caribbean region. The geologic development of Central America from the Cretaceous to the present is outlined.—CRG

06310 **Whetten, John T.; Fullam, Timothy J.** Columbia River bed forms [with French abs.], Paper A14 *in* Internat. Assoc. Hydraulic Research, 12th Cong., 1967, Proc., V. 1: Fort Collins, Colo., Colorado State Univ., p. 107–114, illus., table; discussion, ibid., V. 5, p. 48–49, 1967.

Large sand waves on the bed of the lower Columbia River have been examined [from Bonneville Dam to the mouth] with a seismic profiler. The sand waves vary in size and shape; the largest are up to 200 m long and 5.5 m high. In Bonneville Reservoir, sand waves migrated downstream at a rate of 0.7 m/day during high water discharge in 1966 when bottom current velocities were 50–60 cm/sec. The rate of forward movement decreased with decreasing discharge. Some sand waves [at Reed Island near Washougal, Wash.] are subaerially exposed at low discharges of the river, and are modified by the wind. In areas where wind direction is nearly the same as water current direction, the wind modified sand waves tend to be elongated and flattened.—Authors' abstract

White, Amos M. *See* Overstreet, William C. 00323

06010 **White, William B.; Dachille, Frank; Roy, Rustum.** High pressure polymorphism of As_2O_3 and Sb_2O_3 [with German abs.]: Zeitschr. Kristallographie, v. 125, p. 450–458, illus., table, 1967.

The polymorphic transitions in Sb_2O_3 and As_2O_3 have been examined, utilizing hydrothermal and opposed anvil high pressure techniques. The Sb_2O_3 senarmontite⇌ valentinite reaction occurs in the hydrothermal range with a transition temperature of 606°C; the As_2O_3 arsenolite⇌ claudetite reaction has been shown to be reversible with a transition temperature of 110°C; both at 1 atm.—Authors' abstract

Whitlow, Jesse W. *See* Overstreet, William C. 00323

Whittig, L. D. *See* Hendricks, D. M. 06192

06096 **Wiegel, Egon.** Glen Canyon Damm und Lake Powell—Eindrücke einer Studienfahrt: Deutsch. Geol. Gesell. Zeitschr. 1964, v. 116, no. 3, p. 679–682, 1967.

The country rock in which the Glen Canyon dam and Lake Powell are located consists of more than 400 m of massive to thick bedded Navajo Sandstone of the Lower Jurassic Glen Canyon Group. Details of the geology of the dam site, the history of exploration, and problems of construction are summarized.—GSA Bib. Staff

06238 **Wilkinson, J. F. G.** The petrography of basaltic rocks, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 163–214, illus., tables, 1967.

The classification and petrography of mafic rocks is based on two magma types, tholeiitic and alkali olivine basalt. A summary is given of the distinguishing features of types of rocks derived from each. Basalts derived from tholeiitic magma show a reaction relation between olivine and Ca poor pyroxene, and olivine (if present) occurs only as unzoned phenocrysts. Basalts derived from alkali olivine basalt magma show a cotectic relation between olivine and a Ca rich pyroxene, and olivine occurs as phenocrysts and in ground mass, often showing compositional zoning. The possibility of a third magma type, calc alkaline, is discussed. The more specific classification within the major groups follows that of Nockolds (1954); tables

presenting chemical composition, modes, norms, and mineralogy of the various rock types are given.—AGM

05981 **Willden, Ronald; Thomas, Herman H.; Stern, T. W.** Oligocene or younger thrust faulting in the Ruby Mountains, northeastern Nevada: Geol. Soc. America Bull., v. 78, no. 11, p. 1345–1357, illus., tables, 1967.

A klippe of unmetamorphosed Devonian carbonate rocks rests on the Harrison Pass pluton south of Toyn Creek. This klippe, and other klippen of Carbonifermus strata first mapped by R. P. Sharp (1942) that rest on lower Paleozoic strata, are believed to represent a once-continuous thrust sheet which developed after emplacement of the granodioritic to quartz monzonitic pluton. Five samples of the pluton yielded K-Ar ages on biotite from 29 to 36 m.y. and lead alpha ages from 30 to 40 m.y. The concordance of ages by the two methods establishes a maximum age of Oligocene for the thrusting. The present distribution of thermally metamorphosed Paleozoic rocks excludes the Ruby Mountains for the origin of the plate. Sharp suggested a source 7–10 miles to the west.—RAL

06182 **Williams, B. G.; Drover, D. P.** Factors in gel formation in soil suspensions: Soil Sci., v. 104, no. 5, p. 326–331, illus., table, 1967.

Thixotropic gels can develop in soil suspensions at low electrolyte concentrations and so result in erroneous estimates of clay percentages. Factors investigated included soil suspension concentration, particle-size distribution, clay mineralogy, type and concentration of electrolyte, and time of settling.—JWH

06365 **Williams, E. P.** Oil and gas possibilities in Prince Edward Island: Canadian Mining and Metall. Bull., v. 60, no. 668, p. 1429–1434, illus., table, 1967.

Prince Edward Island is centrally located within the Maritimes Basin, a large intermontane structure in the Appalachian orogenic belt, known to be petroliferous from seeps, shows, oil shales, albertite, and the producing field in New Brunswick. Prospective reservoir rocks in Prince Edward Island are the Mississippian Horton and Windsor Groups on or over structural highs in the basement, on anticlines or fault highs, over or peripheral to salt domes or salt-cored anticlines, at truncation pinchouts of beds, in basal sandstone or granite wash on the pre-Carboniferous basement, and in facies traps at changes from sandstone to shale or porous to tight carbonate rocks.—VSN

06205 **Wilson, Charles W., Jr.** Geologic map of the Linden quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 32-SE, scale 1:24,000, separate text, 1967.

Mined mineral resources in the Linden quadrangle are chert and limestone; potential resources are sand and gravel and blue phosphate. Chert is residual material derived from the Mississippian Fort Payne Formation; two of the nine pits are active. The Decatur, Lego, Laurel, and Bob Lomestones are the best sources of general-purpose and agricultural limestone.—MCM

06206 **Wilson, Charles W., Jr.; Barnes, Robert H.** Geologic map of the Center Hill Dam quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 322-SE, scale 1:24,000, separate text, 1967.

Mined mineral resources in the Center Hill Dam quadrangle are limestone and fluorite; potential resources are gravel and chert. Of the several exposed limestone formations, the Bigby-Cannon is best suited for most general uses; the Leipers and Catheys Formations are less desirable. Approximately 30 tons of fluorite has been mined in a shaft, 165 feet vertically below the Chattanooga Shale; country rock is the Catheys Formation. Potential resources are chert and gravel.—MCM

Wilson, Charles W., Jr. *See* Hershey, Robert E. 06210

06225 **Wilson, Charles W., Jr.** Geologic map of the Pine View quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 32-NW, scale 1:24,000, separate text, 1967.

Mineral resources mined in the Pine View quadrangle are phosphate, chert, and gravel. White phosphate occurs as angular and irregularly shaped chunks ranging up to boulder size and disseminated in soil that fills solution channels in the Rockhouse Limestone Member of the Ross Formation or in the Decatur Limestone. Chert is residual material derived from weathering of the Mississippian Fort Payne Formation and the Devonian Camden and Harriman Formations. Sizeable deposits of chert gravel are found in alluvial deposits on flood plains and in beds of larger streams. A potential resource is limestone.—MCM

06226 **Wilson, Charles W., Jr.; Kirby, James P.** Geologic map of the Pulaski quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 59-NE, scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Pulaski quadrangle, Tennessee," by R. E. Hershey, and C. W. Wilson, Jr. is cited separately.—MCM

06230 **Wilson, Charles W., Jr.; Russell, Ernest E.** Geologic map of the Scotts Hill quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 22-SW, scale 1:24,000, separate text, 1967.

The only mineral resource mined in the Scotts Hill quadrangle is chert; potential resources are limestone, phosphate, and sand. The seven inactive chert pits are in the Harriman Formation; the chert was used primarily for road metal.—MCM

06402 **Winkler, Helmut G. F.** Petrogenesis of metamorphic rocks (2d edition): New York, Springer Verlag, 237 p., illus., tables, revised 1967; originally published 1965.

The textbook, translated from the German in 1965, stresses the mineralogical-chemical aspects of metamorphic rocks. Petrofabrics analysis is not discussed, nor time relations between orogenies and metamorphism. The second edition is enlarged and expanded with significant changes in eight chapters. Subjects cover: definition and types of metamorphism; factors; concept of metamorphic facies; reactions in carbonate rocks; graphical representation of mineral paragenesis; hornfels facies of contact metamorphism; regional dynamothermal metamorphism; Barrovian-type facies; Abukuma-type facies; intermediate facies; granulitic facies; eclogites; change of chemical composition of minerals with progressive metamorphism; burial metamorphism; temperature and pressure conditions of regional dynamothermal metamorphism; anatexis, formation of migmatites, and origin of granitic magmas. An appendix gives the nomenclature of common metamorphic rocks.—ESL

00271 **Wollenberg, Harold A.; Smith, Alan R.** Radiogeologic studies in the central part of the Sierra Nevada batholith, California: Jour. Geophys. Research, v. 73, no. 4, p. 1481-1495, illus., tables, 1968.

Radioactivity in granitic rocks of the central Sierra Nevada varies both regionally and with rock type. Dating and radioactivity studies on the west slope are consistent with the concept of a vertically fractionated batholith with heat sources concentrated in the upper parts. East of the crest the age and radioactivity relations do not fit the concept so well, perhaps due to originally inhomogeneous distribution of radioactive minerals in the magma source rock. Proportions of U, Th, and K are generally constant within a given pluton and within those of similar composition and age, but they are different in plutons that are compositionally and temporally unrelated. Recent geologic work and isotopic dating have shown some incorrect correlations made on the basis of petrographic similarity.—KAS

06027 **Wones, David R.; Tatlock, Donald B.; vonLimbach, Dora.** Coexisting orthoclase and microcline in altered volcanic rocks, West Humboldt Range, Pershing County, Nevada: Schweizer. Mineralog. u. Petrog. Mitt., v. 47, no. 1, p. 169-176, table, 1967.

Coexisting orthoclase and microcline occur in volcanic rocks altered by pervasive potassium metasomatism. The two polymorphs occur together, the microcline as phenocrysts, and the orthoclase in the groundmass with quartz and muscovite. The Or content of the potassic feldspars exceeds 87 percent, and the triclinic K-feldspars have "obliquities" greater than 0.80. No intermediate microclines were detected.

The assemblage is best explained by alkali exchange and recrystallization of plagioclase to microcline (±muscovite) and sanidine or glass to orthoclase, rather than a transition between the two polymorphs.—Authors' abstract

Wood, G. V. *See* Illing, L. V. 06399

Woolley, W. C. *See* Musgrave, A. W. 06287

00292 **Wyckoff, Ralph W. G.; Doberenz, Alexander R.** The strontium content of fossil teeth and bones: Geochim. et Cosmochim. Acta, v. 32, no. 1, p. 109–115, tables, 1968.

X-ray spectrometric analyses were made of the strontium contents of about 200 Recent and fossil teeth and bones of different ages from many localities. The amount of strontium does not increase progressively with age but is related to locality. Where comparison has been possible it is invariably higher than that of the matrix rock. There is evidence that this trace element may be an original component of the fossil rather than the result of subsequent alteration.—Authors' abstract

06013 **Wyoming Geological Association.** Symposium on recently developed geologic principles and sedimentation of the Permo–Pennsylvanian of the Rocky Mountains—20th Ann. Conf., Casper, 1966: Casper, Wyo., Petroleum Inf., [188] p., illus., tables [1967?].

The symposium presents recent data from work in the field of sedimentation that can be applied directly to oil exploration. Half of the program deals with recent data on: (1) sedimentation of carbonates, deltaic sands and sandstones; (2) diagenesis of carbonates, and sandstones, and (3) application of diagenetic principles to petroleum exploration. The second half is concerned with new data in the sedimentation of the Permo–Pennsylvanian rocks of the Rocky Mountains. Eight papers and two abstracts of papers are cited separately.—KAS

06243 **Yagi, Kenzo.** Silicate systems related to basaltic rocks, *in* Basalts—The Poldervaart treatise on rocks of basaltic composition, V. 1 (H. H. Hess and A. Poldervaart, editors): New York and London, Interscience Publishers, p. 359–400, illus., 1967.

Many well known ternary silicate diagrams are complicated by solid solution relations, particularly between pyroxenes and plagioclase. An attempt is made to construct quaternary equilibrium diagrams of relevance to basaltic rocks, including the "simple basalt system." Recent high pressure experiments indicate that the various basalt magma types can be produced by the partial melting of the same peridotitic material at different levels in the mantle. Experiments using natural basalt as the starting point indicate that basaltic magma is located in the olivine phase volume of multicomponent systems. The order of separation of the minerals is olivine, plagioclase, and pyroxene, but the latter two appear almost simultaneously and all appear within 1170–1250°C.—AGM

Yaniv, Akiva. *See* Gradsztajn, Eli. 00212

06031 **Yoho, W. Herbert.** Preliminary report on basement complex rocks of Iowa: Iowa Geol. Survey Rept. Inv. 3, 19 p., illus., table, 1967.

Crystalline basement rock has been encountered in the bottom hole samples of about 45 wells in Iowa. Fairly detailed studies of the samples from most of these wells have been made. Granite is the predominant rock type thus far encountered, followed by diabase in order of abundance. A summary description of the different kinds of crystalline rocks that have been encountered is presented along with a convenient table listing the pertinent data for each well. An index map showing the location and relationship of these wells one to another is included. Detailed descriptions are available in the open files of the Iowa Geological Survey.—Author's abstract

00361 **Young, Grant M.** Sedimentary structures in Huronian rocks of Ontario: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 4, no. 2, p. 125–153, illus., tables, 1968.

Sedimentary structures from various formations and places are interpreted. Crossbedding and ripple marks in the south and in the Cobalt–Gowganda area show a southerly transport direction; shallow-water features are present also. The Gowganda tillite suggests southerly ice movement. Clastic dikes in some rocks indicate tectonic activity during deposition. A positive area around Sudbury is recognized also. In the Bruce Mines–Blind River area, Huronian ice moved to the southwest down a paleoslope, whereas water-laid sediments of the same time show a southeastward transport. Turbidity currents are identified also by various features, but a glacial origin for the conglomerates and banded argillites is clearly recognized.—HRC

06121 **Zen, E-an.** Application of one-dimensional lattice model to mixed-layer muscovite–montmorillonite [abs.], *in* Clays and clay minerals—Clay Minerals Conf., 15th, Pittsburgh, Pa., 1966, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 27), p. 49, 1967.

INDEX

[The numbers refer to entries in the abstracts]

Absolute age, dates
Carbon-14
Alaska, Fairbanks area, permafrost tunnel, Wisconsin section: Sellman, Paul V. 06126
Alaska, glacial drift: Porter, Stephen C. 06052
Northwest Territories, Ellesmere Island, shells: Hattersley-Smith, G. 06053
Soil humus, residence time: Campbell, C. A. 06265
Granitic rocks
California, Sierra Nevada batholith, vertical fractionation concept: Wollenberg, Harold A. 00271
Nevada, Ruby Mountains, Oligocene age: Willden, Ronald. 05981
Igneous rocks
Minnesota, Granite Falls area, mafic dikes: Hanson, G. N. 06018
Northwest Territories: Heywood, W. W. 06045
Metamorphic rocks
Northwest Territories: Heywood, W. W. 06045
Meteorites
Four Corners, Toluca, silicate inclusions: Bogard, D. 00314
Rhyolite
California, Mono and Inyo Craters, K-Ar: Dalrymple, G. Brent. 00326
California, Mono and Inyo Craters, U-Th: Taddeucci, Adriano. 00315
Sedimentary rocks
Barbados, coral reefs, Th/U, Pa/U, Milankovitch hypothesis: Broecker, Wallace S. 00211

Absolute age, methods
Carbon-14
Soils, techniques, humic fraction: Campbell, C. A. 06265
Potassium-argon
Choice of samples, lack of criteria: Ozima, M. 00272
Thorium-uranium
Soil, rate of formation: Hansen, R. O. 00343
Uranium-lead
Concordia plots: Russell, R. D. 00372

Alabama
Economic geology
Mineral resources, industry, production: Szabo, Michael W. 06375
Geophysical surveys
Heflin area, seismic, electrical: Joiner, Thomas J. 06376
Hydrogeology
Heflin area, ground water, exploration: Joiner, Thomas J. 06376
Paleontology
Conodonts, Devonian, Gassaway Member, redescription: Huddle, John W. 00209

Alaska
Absolute age
Glacial drift, Chagvan Bay area: Porter, Stephen C. 06052

Alaska
Absolute age
Quaternary silt, Wisconsin section, Fairbanks area, permafrost tunnel, C-14: Sellman, Paul V. 06126
Areal geology
Upper Chistochina River area: Rose, Arthur W. 06314
Earthquakes
June 21, 1967, Fairbanks area: Cloud, William K. 00167
June-July 1967, Fairbanks area, preliminary report: Jordan, James N. 00201
March 28, 1964, effects: Hansen, Wallace R. 06004
March 28, 1964, geomagnetic field effects: Hirshberg, Joan. 00203
March 1964, February 1965, free oscillations and Q values: Nowroozi, A. A. 00273
Economic geology
Oil shale, northern, geochemistry, oil yield: Tourtelot, Harry A. 06261
Petroleum, natural gas, Cook Island Inlet basin: Osment, F. C. 06404
Engineering geology
Earthquakes, Fairbanks area, June 21, 1967: Cloud, William K. 00167
Geochemistry
Meade River-Colville Delta area, eolian soils: Rickert, D. A. 06175
Seward Peninsula, Sn-W-Be district, geochemical prospecting: Sainsbury, C. L. 06362
Geomorphology
Meade River-Colville Delta area, eolian soils: Rickert, D. A. 06175
Glacial geology
Chagvan Bay area, drift, age: Porter, Stephen C. 06052
Mendenhall Valley: Barnwell, William W. 00373
Maps, geochemical
Seward Peninsula, Lost River valley: Sainsbury, C. L. 06362
Maps, geologic
Hooper Bay quadrangle: Hoare, J. M. 00332
Mendenhall Valley, surficial: Barnwell, William W. 00373
Seward Peninsula, Lost River valley: Sainsbury, C. L. 06362
Upper Chistochina map-area: Rose, Arthur W. 06314
Maps, ground water
Mendenhall Valley: Barnwell, William W. 00373
Maps, paleogeographic
Mendenhall Valley: Barnwell, William W. 00373
Paleontology
Trilobita, Cambrian, Jones Ridge Limestone, east-central: Palmer, Allison R. 00264
Stratigraphy
Cambrian, east-central: Palmer, Allison R. 00264

Alaska
Stratigraphy
Cretaceous, Quaternary, Hooper Bay quadrangle: Hoare, J. M. 00332
Mesozoic, Quaternary, Mendenhall Valley, sections: Barnwell, William W. 00373
Quaternary, Wisconsin section, Fairbanks area, permafrost tunnel: Sellman, Paul V. 06126

Alberta
Economic geology
Oil sand, Athabasca tar, properties: Carrigy, M. A. 06255
Petroleum, northwestern, exploration, Devonian reefs: Hriskevich, M. E. 06236
Geomorphology
Drayton Valley area, North Saskatchewan River, gravel bed forms: Galay, V. J. 06159
Geophysical surveys
Seismic, application of Dinoseis system: Godfrey, L. M. 00183
Maps, geologic
Waterton gas field region: Herr, R. L. 06103
Paleontology
Palynomorphs, Cretaceous, Colorado Group, central: Norris, G. 06034
Sedimentary petrology
Mississippian carbonates, porosity, Harmattan oil fields: Lucia, F. Jerry. 06437
Stratigraphy
Cambrian, Upper, Lynx Group, southwestern, revision: Aitken, J. D. 06140
Cretaceous, Alberta Group, Waterton gas field, correlation: Herr, R. L. 06103
Cretaceous, Colorado Group, biostratigraphy: Norris, G. 06034
Mississippian, southwestern, facies: Macqueen, R. W. 06102

Amphibia
Morphology
Tupilakosaurus, Triassic, skull roof: Nielsen, Eigil. 06381
Tupilakosaurus heilmani
Triassic, Greenland, Kap Stosch, skull roof, reinterpretation: Nielsen, Eigil. 06381

Angiosperms
Cretaceous
California, Panoche Formation, central: Page, Virginia M. 00345
Lupinus arcticus
Pleistocene, Yukon, seeds, laboratory germination: Black, Michael. 06127
Plataninium californicum, n.sp.
Cretaceous, California, Panoche Formation: Page, Virginia M. 00345
Plataninium platanoides, n.sp.
Cretaceous, California, Panoche Formation: Page, Virginia M. 00345
Tetracentronites panochetris, n.sp.
Cretaceous, California, Panoche Formation: Page, Virginia M. 00345

Arctic
Maps, tectonic
Recent movements: Puminov, A. P. 06421

Arctic
Structural geology
Tectonics, recent, map: Puminov, A. P. 06421

Argon
Geochemistry
Chondritic meteorites, unequilibrated, analyses: Heymann, D. 00297

Arizona
Engineering geology
Dams, Colorado River, Glen Canyon, site geology: Wiegel, Egon. 06096
Geomorphology
San Francisco Mountain Volcanic Field, cones and flows: Colton, Harold S. 06308
Maps, geologic
Brandenburg Mountain quadrangle: Krieger, Medora H. 00327
Holy Joe Peak quadrangle: Krieger, Medora H. 00328
Mineralogy
Herschelite, Bowie area, gradation from chabazite: Regis, A. J. 06203
Smectite, northeastern, Bidahochi Formation, genesis: Sloane, Richard L. 06118
Sedimentary petrology
Northeastern, Bidahochi Formation, tuff, alteration to smectite: Sloane, Richard L. 06118
Stratigraphy
Brandenburg Mountain quadrangle, map unit descriptions, sections: Krieger, Medora H. 00327
Holy Joe Peak quadrangle, map unit descriptions, sections: Krieger, Medora H. 00328
Volcanology
San Francisco Mountain Volcanic Field, history, cone and flow classification: Colton, Harold S. 06308

Arkansas
Engineering geology
River control, Vicksburg District: Anding, Malcolm G. 06163
Hydrogeology
Grand Prairie region, recharge, aquifer and well characteristics: Johnson, A. I. 06125
Sedimentary petrology
Grand Prairie region, sediments, aquifer and well: Johnson, A. I. 06125
Stratigraphy
Mississippian, Upper, northern, nomenclature revision: Ogren, David E. 00306

Associations
Clay Minerals Conference
Proceedings, 15th, 1966, Pittsburgh, Pa.: Bailey, S. W. 06116
Clay Minerals Society
Nomenclature Committee, report 1965–66: Brindley, G. W. 06186
Geochemical Society
Symposium, nutrition, geology, and trace elements: Cannon, Helen L. 06211
International Clay Conference
Proceedings, 1966: Heller, L. 06221

Associations
International Geological Congress
History, founding committee, 1876, U.S.A.: Thurston, William. 00340
Society Exploration Geophysicists
37th annual meeting, presidential address: Smith, Neal J. 00182
Society of Petroleum Engineers
Index to publications, 1953–66: Bradley, Howard B. 06268
Wyoming Geological Association
Symposium, sedimentation, Permo-Pennsylvanian strata, Rocky Mts.: Wyoming Geological Association. 06013
Atlantic Coastal Plain
Sedimentary petrology
Beach sand, carbonate fraction: Pilkey, Orrin H. 06373
Atlantic Ocean
General
Northern, geologic age: Rioult, Michel. 06361
Geochemistry
Radium-226, radon-222 distribution: Broecker, Wallace S. 06232
Sedimentary petrology
Great Bahama Bank, sediments, gelatinous binding: Bathurst, R. G. C. 06370
Sediments, elasticity vs. porosity and grain diameter: Schreiber, B. Charlotte. 00285
Structural geology
Mid-Atlantic Ridge, tectonics, geologic, geophysical data: VanAndel, Tjeerd H. 00286
Northern, wrench faulting, rifting, palinspastic restoration: Webb, Gregory W. 00172
Automatic data processing
Economic geology
Petroleum exploration, migration, entrapment, computer simulation: Harbaugh, John W. 06447
General
Computer systems, storage and retrieval: Dillon, E. L. 06452
Computer use in geology: Merriam, Daniel F. 06007
Current research, automatic plotters: Davies, David K. 06410
Hydrogeology
Aquifer management, analysis techniques: Bittinger, M. W. 06115
Ground-water seepage flow, Pavlovsky's solution, computer program: Papadopoulos, George T. 00194
Mineral exploration
Marine, shipboard requirements: Schneidewind, N. F. 06301
Mineralogy
Crystal structure analysis, Patterson function: Abrahams, S. C. 05996
Sedimentary petrology
Grain-size data: Schlee, John. 06430
Automatic data processing
Sedimentation
Coal-bearing deltas, computer models: Oertel, G. 06041
Soils
Particle-size distribution, textural classification, computer: Schreiber, H. A. 06264
X-ray diffraction analysis
Montmorillonite, mica, profiles, computer calculation: Ross, Malcolm. 06120
Barbados
Absolute age
Coral reefs, deep-sea sediments, Milankovitch hypothesis: Broecker, Wallace S. 00211
Basins, structural
California
Los Angeles Basin, Pliocene sedimentary history: Conrey, Bert L. 05999
Canada
Carboniferous rift valleys, correlation with British Isles: Belt, Edward S. 06368
Evolution
Forest City basin, Iowa-Missouri-Kansas-Nebraska: Anderson, K. H. 00265
Batholiths
California
Sierra Nevada, geologic history: Bateman, Paul C. 06158
Sierra Nevada, heat flow, radioactivity, absolute age: Wollenberg, Harold A. 00271
Bibliography
Authors
Poldervaart, Arie: Bucher, Walter H. 06246
Foraminifera
Recent literature, annotated: Todd, Ruth. 00338
General
Review articles: Hawkes, H. E. 06377
Glacial geology
Periglacial features: Hamelin, Louis-Edmond. 06309
Paleontology
Vertebrata, and related subjects, 1965–66: Blake, Martha A. 06020
Seismic methods
Refraction, techniques and interpretation: Musgrave, Albert W. 06277
Vertebrata
Kentucky, Pleistocene: Jillson, Willard Rouse. 00367
Biography
Gorman, Joseph M.: Becker, Leroy E. 00350
Poldervaart, Arie
Bibliography: Bucher, Walter H. 06246
Teilhard de Chardin, Pierre: Speaight, Robert. 06021
Brachiopoda
Morphology
Spiriferina, Triassic, morphogenesis, valve structures: Logan, A. 06149
Spiriferina (Rastelligera) canadensis n.sp.
Triassic, Northwest Territories, Ellesmere Island, morphogenesis: Logan, A. 06149

Brachiopoda
Spiriferina (Spiriferina) ellesmerensis, n.sp.
Triassic, Northwest Territories, Ellesmere and Table Islands: Logan, A. 06149

British Columbia
Economic geology
Petroleum, northeastern, exploration, Devonian reefs: Hriskevich, M. E. 06236

California
Absolute age
Glass Mountain, rhyolite flows, obsidian hydration dates: Friedman, Irving. 00171
Owens Valley, Mono and Inyo Crater lava, K-Ar: Dalrymple, G. Brent. 00326
Owens Valley, Mono and Inyo Crater volcanics: Taddeucci, Adriano. 00315
Sierra Nevada batholith: Wollenberg, Harold A. 00271
Areal geology
General, geologic history: King, P. B. 00364
Earthquakes
1960, Jan. 19 and April 8, Hollister, seismoscope results: Cloud, William K. 06418
1966, June 27 main shock, Parkfield, seismoscope results: Cloud, William K. 06418
June 1966, Parkfield area, San Andreas fault, errata: Hofmann, R. B. 06075
September 14, 1963, Chittenden area: Brabb, Earl E. 06295
Engineering geology
Clays, San Francisco Bay mud, cyclic stress strain characteristics: Thiers, Gerald R. 00324
Foundations, Central Valley, Dos Amigos Pumping Plant, rebound: Stoll, Ulrich W. 00200
Materials, properties, central, subsiding areas, sediments: Johnson, A. I. 00312
Geochemistry
Riverside County, Lakeview Mtn. Tonalite, variability, sampling: Baird, A. K. 06389
San Gorgonio Pass, piemontite gneiss, Fe, Mn valence equilibria: Smith, Douglas. 06105
Geomorphology
Tehama County, erosion surfaces: Lydon, Philip A. 06387
Hydrogeology
Ground water resources, development plans: Johnson, Thelma A. 06113
Los Angeles basin, model study: Chun, Robert Y. D. 06106
Maps, geologic
Ben Lomond Mountain area: Leo, Gerhard W. 06294
Los Angeles County, detailed areas, Castaic Formation: Stanton, Robert J., Jr. 06390
Salt Spring Hills, southern: Troxel, Bennie W. 06357
Maps, isopach
Los Angeles Basin, lower Pliocene: Conrey, Bert L. 05999

California
Maps, lithofacies
Los Angeles Basin, lower Pliocene: Conrey, Bert L. 05999
Mineralogy
Analcite, San Bernardino County, Barstow Formation: Gude, Arthur J., 3d. 06201
Chrysotile, Coalinga area, lack of amorphous material: Fripiat, J. J. 06185
Clay minerals, Cascade Range, saprolites from andesites: Hendricks, D. M. 06192
Pyroxene, blueschist facies, central: Coleman, R. G. 00276
Santa Cruz area, Kalkar limestone quarry: Gross, Eugene B. 06388
Paleontology
Angiosperms, Cretaceous, Panoche Formation, central: Page, Virginia M. 00345
Foraminifera, Cretaceous, Hex Formation, Kern County: Church, Clifford C. 00170
Foraminifera, Cretaceous, Maestrichtian, orthokarstenids: Graham, Joseph J. 06359
Foraminifera, Eocene, San Juan Bautista Formation: Waters, J. N. 00329
Invertebrata, Miocene, Castaic Formation, Los Angeles County, list: Stanton, Robert J., Jr. 06390
Microfossils, Tertiary, Los Angeles Basin, lower Pliocene, list: Conrey Bert L. 05999
Palynomorphs, protista, Cretaceous, Moreno Formation, Fresno County: Drugg, W. S. 06100
Pelecypoda, Miocene, Monterey Formation, burrows: Evans, John W. 06036
Petrology
Ben Lomond Mountain area, plutonic and metamorphic rocks: Leo, Gerhard W. 06294
Sierra Nevada batholith: Bateman, Paul C. 06158
Tuscan Buttes, volcanic plugs, cf. tuffaceous Tuscan Formation: Lydon, Philip A. 06387
Yosemite Valley, granitic intrusive units, reclassification: Smith, Arthur R. 06360
Sedimentary petrology
Central, subsiding areas, sediments: Johnson, A. I. 00312
Los Angeles Basin, Pliocene strata, lower, depositional history: Conrey, Bert L. 05999
Stratigraphy
Cretaceous-Paleocene, Moreno Formation, Escarpedo Canyon: Drugg, W. S. 06100
Miocene, Castaic Formation, Los Angeles County: Stanton, Robert J., Jr. 06390
Precambrian-Cambrian, Kingston Peak-Zabriskie Formations, Salt Spring Hills: Troxel, Bennie W. 06357
Tertiary, Los Angeles Basin, Pliocene, lower, cross sections: Conrey, Bert L. 05999
Tertiary, San Juan Bautista Formation, basal, Eocene age: Waters, J. N. 00329

California
Structural geology
Ben Lomond Mountain area, intrusions, deformation: Leo, Gerhard W. 06294
Cambrian
Alaska
East-central, Trilobita, biostratigraphy: Palmer, Allison R. 00264
Alberta
Nomenclature, Lynx Group, Waterfowl, Bison Creek, Mistaya Formations: Aitken, J. D. 06140
Rocky Mountains, Upper, stratigraphy, revision: Aitken, J. D. 06140
California
Salt Spring Hills, Wood Canyon and Zabriskie Formations: Troxel, Bennie W. 06357
Invertebrata
Evolution of hard shell, relation to lunar tides: Lamar, D. L. 06006
North America
Correlation, lower boundary: Rozanov, A. Yu. 06051
North Carolina
Great Smoky Mountains National Park: King, Philip B. 00263
Northwest Territories
Ellesmere Island, stratigraphy: Kerr, J. William. 06306
Nomenclature, Ellesmere Island: Kerr, J. William. 06306
Tennessee
Great Smoky Mountains National Park: King, Philip B. 00263
Canada
Economic geology
Copper-zinc, Archean sulfides, remobilization: Suffel, G. G. 06273
Iron, eastern, Appalachian and Grenville regions, occurrence: Gross, G. A. 06296
Nickel, occurrences, exploration, mining methods: Boldt, Joseph R., Jr. 06321
Oil sands, occurrence, major deposits: Phizackerley, P. H. 06254
Petroleum, exploration, seismic reflection, interpretation: Boulware, Robert A. 06398
Petroleum, northwestern, exploration, Devonian reefs: Hriskevich, M. E. 06236
Uranium, distribution, production, reserves, history: Griffith, J. W. 06293
General
Research, Geological Survey, 1967: Canada Geological Survey. 00368
Geochemistry
Differential thermal analysis equipment, Dept. Energy, Mines, Resources: Lake, Richard H. 06151
Feldspar, ion migration: Rimsaite, J. 06026
Geophysical surveys
Bay of Fundy, magnetic, ship-based helicopter, experiment: Sawatzky, P. 06316
Gulf of Saint Lawrence region, gravity, Orpheus anomaly: Loncarevic, B. D. 06401
Canada
Geophysical surveys
Hudson Bay, seismic refraction: Hobson, George D. 06446
Maps, geologic
Eastern, Appalachian and Grenville regions, iron deposits: Gross, G. A. 06296
Maps, mineral resources
Eastern, Appalachian and Grenville regions, iron deposits: Gross, G. A. 06296
Mineralogy
Feldspar, heterogeneity, composition, rock correlation: Rimsaite, J. 06026
Stratigraphy
Carboniferous, cementstone facies, correlation with British Isles: Belt, Edward S. 06368
Structural geology
Hudson Bay, seismic study: Hobson, George D. 06446
Carbon
Isotopes
C-13, C-12, fractionation, calcareous marine invertebrates: Weber, Jon N. 00299
C-14, marine shells: Taylor, R. E. 06233
Carboniferous
Canada
Eastern, cementstone facies, correlation with British Isles: Belt, Edward S. 06368
Caribbean region
Paleogeography, paleotectonic reconstruction: Rod, Emile. 06266
Caribbean region
Economic geology
Nickel, lateritic deposits, reserves: Boldt, Joseph R., Jr. 06321
Paleontology
Echinoidea, Eocene, oligopygoids, revision: Kier, Porter M. 06057
Stratigraphy
Jurassic-Recent, paleogeography: Weyl, R. 06022
Structural geology
Carboniferous-Mesozoic, paleotectonic reconstruction: Rod, Emile. 06266
Caribbean Sea
Sedimentary petrology
Sediments, elasticity vs. porosity and grain diameter: Schreiber, B. Charlotte. 00285
Caves
Features
General: Black, Herbert L. 06224
Genesis
General: Black, Herbert L. 06224
United States
Descriptions, collected papers: Black, Herbert L. 06224
Cenozoic
Pelecypoda
Morum, fossil and Recent, nomenclature: Dance, S. Peter. 06035
Central America
Stratigraphy
Cretaceous-Tertiary, paleogeography, southern: Henningsen, D. 06095

Central America
Stratigraphy
Paleozoic Recent, paleogeography: Weyl, R. 06022
Structural geology
Carboniferous Mesozoic, paleotectonic reconstruction: Rod, Emile. 06266
Changes of level
Barbados
Pleistocene, terraces: Broecker, Wallace S. 00211
Nova Scotia
Quaternary, postglacial: Swift, Donald J. P. 06367
Rates
Northwest Territories, Ellesmere Island: Hattersley-Smith, G. 06053
Clay mineralogy
Areal studies
Arizona, northeastern, Bidahochi Formation, tuff, alteration to smectite: Sloane, Richard L. 06118
California, Cascade Range, saprolites from andesites: Hendricks, D. M. 06192
Kansas, Neosho River valley, Pleistocene deposits: Jamkhindikar, Suresh. 06002
Ontario, Blue Mountain nepheline deposit, biotites, weathering: Rimsaite, J. 06191
Wyoming, Yellowstone Natl. Park, mud pots, alteration sequence: Droste, John B. 06271
Experimental studies
Alkali metals, marine sediments, evolution, relation to ocean water: Harriss, Robert C. 06204
Alteration, alkaline solutions, influence: Ferrell, Ray E., Jr. 06197
Clay-water systems, electrical resistivity, pressure effects: Lang, W. J. 06272
Conference: Bailey, S. W. 06116
Iron content, Mossbauer spectroscopy: Pecuil, T. E. 06112
Kaolinite group, intersalation and interlayer hydration: Deeds, C. T. 06223
Micas, K depletion, color changes and increase in thickness: Scott, A. D. 06190
Montmorillonite, alcohol-water interactions, ethanol: Dowdy, R. H. 06196
Montmorillonite, alteration to gibbsite: Turner, R. C. 06183
Montmorillonite, crystallite size and shape: Jonas, Edward C. 06119
Montmorillonite, deposition from suspension in porous media: Curry, R. Bruce. 06189
Montmorillonite, interactions with soil humic compound: Kodama, H. 06195
Montmorillonite platelets, interaction, X ray study: Andrews, Donald E. 06188
Montmorillonite, X ray diffraction analysis, 13, 20 band profile: Mering, J. 06122
Muscovite-montmorillonite, mixed layer, one dimensional lattice model: Zen, E an. 06121
Soils, content, estimation, gel formation effects: Williams, B. G. 06182
Clay mineralogy
Experimental studies
Vermiculite, dioctahedral, *b* dimensions: Leonard, R. A. 06108
Vermiculite-mica, interstratification, genesis: Sawhney, B. L. 06107
Water sorption at high temperatures, correlation with fluorine: Granquist, W. T. 06111
X ray diffraction analysis, orienting internal standard: Mossman, M. H. 06187
X ray diffraction, illite, preparation techniques, effects: Fenner, Peter. 06222
General
Conference proceedings: Heller, L. 06221
Mineral data
Conference: Bailey, S. W. 06116
Hydrobiotite-vermiculite, variations in single flake: Weed, S. B. 06184
Illite-montmorillonites, order of mixed layering, expandability: Hower, John. 06123
Montmorillonite, alcohol-water interactions: Dowdy, R. H. 00344
Montmorillonite, alteration to gibbsite, experiment: Turner, R. C. 06183
Montmorillonite, crystallite size and shape: Jonas, Edward C. 06119
Montmorillonite, exchange equilibria: Bolt, G. H. 06311
Montmorillonite, exchange equilibria: Kemper, W. D. 06315
Montmorillonite, mica, X-ray diffraction profiles, computer calculation: Ross, Malcolm. 06120
Montmorillonite, water adsorption, resistivity studies: Lang, W. J. 06272
Smectite, Arizona, genesis, tuff alteration: Sloane, Richard L. 06118
Smectite group, properties, expansion and collapse: Harward, M. E. 06198
Vermiculite, composition, variation, relation to particle size: Kerns, Raymond L., Jr. 06109
Vermiculite, dioctahedral, *b* dimensions: Leonard, R. A. 06108
Vermiculite group, properties, expansion and collapse: Harward, M. E. 06198
Vermiculite-mica, interstratification, genesis: Sawhney, B. L. 06107
Nomenclature
Clay Minerals Society recommendations, 1965-66: Brindley, G. W. 06186
Clays
Experimental studies
Kaolinite, viscoelastic shear response: Krizek, Raymond J. 06194
Coal
Properties
Magnetic susceptibility, variation with rank: Bivins, Doris. 00377
Colorado
Areal geology
Denver, Alameda Avenue cut, guidebook: MacKenzie, D. B. 00193

Colorado
Economic geology
Oil shale, occurrence, Green River Formation: Donnell, John R. 06259
Oil shale, Piceance Basin, evaluation, density logs: Tixier, M. P. 06262
Engineering geology
Tunnels, Straight Creek, pilot bore, construction parameters: Scott, J. H. 00376
Geochemistry
Summitville mining district, geochemical prospecting, metals: Sharp, William N. 00355
Uinta Basin, oil shale, kerogen, Fe-Ni ratio: Houghton, A. Sherrill. 06260
Geomorphology
Great Sand Dunes National Monument, dune types, sand source: Johnson, Ross B. 00180
Geophysical surveys
Golden to Albuquerque, N. Mex., seismic, crustal structure: Sherburne, Roger W. 06073
Straight Creek Tunnel pilot bore, seismic, electrical: Scott, J. H. 00376
Maps, geochemical
Summitville mining district: Sharp, William N. 00355
Maps, geologic
Powderhorn–Black Canyon region, Tertiary volcanics: Olson, J. C. 00374
Paleomagnetism
Precambrian, Front Range, reversals, pole position: Eggler, D. H. 00369
Petrology
Powderhorn–Black Canyon region, Tertiary volcanics: Olson, J. C. 00374
Sedimentary petrology
Denver, Alameda Avenue cut, Dakota Sandstone: MacKenzie, D. B. 00193
Paradox basin, carbonate mounds, deposition, diagenesis: Peterson, James A. 05987
Stratigraphy
Devonian system: Baars, D. L. 00181
Pennsylvanian–Permian systems, Denver Basin, paleogeography: Momper, James A. 05988
Precambrian, Great Basin: Condie, Kent C. 06355
Tertiary, volcanics, Powderhorn–Black Canyon region: Olson, J. C. 00374
Colorado Plateau
Stratigraphy
Devonian system: Baars, D. L. 00181
Connecticut
Areal geology
Old Lyme quadrangle: Lundgren, Lawrence, Jr. 06000
Glacial geology
Hartford South quadrangle, surficial deposits: Deane, R. E. 06097
Maps, geologic
Hartford South quadrangle, surficial: Deane, R. E. 06097
Old Lyme quadrangle: Lundgren, Lawrence, Jr. 06000
Connecticut
Maps, geologic
Waterbury quadrangle: Gates, Robert M. 06098
Petrology
Waterbury quadrangle, Waterbury and Hartland gneiss complexes: Gates, Robert M. 06098
Stratigraphy
Precambrian–Cambrian(?), Waterbury and Hartland Formations, Waterbury quadrangle: Gates, Robert M. 06098
Conodonts
Devonian
Alabama, Gassaway Member, redescription: Huddle, John W. 00209
New York, Rhinestreet Shale, redescription: Huddle, John W. 00209
Mississippian(?)
Tennessee, "Hardin sandstone", redescription: Huddle, John W. 00209
Nomenclature
Devonian–Mississippian(?), Ulrich and Bassler types, eastern U.S.: Huddle, John W. 00209
Construction materials
Tennessee
Linden quadrangle, chert: Wilson, Charles W., Jr. 06205
Pine View quadrangle, chert: Wilson, Charles W., Jr. 06225
Pulaski quadrangle, chert: Hershey, Robert E. 06210
Scotts Hill quadrangle, chert: Wilson, Charles W., Jr. 06230
Continental drift
Atlantic Ocean
Paleozoic, late, rifting, palinspastic restoration: Webb, Gregory W. 00172
Caribbean region
Carboniferous–Mesozoic, paleotectonic reconstruction: Rod, Emile. 06266
Causes
Sea-floor spreading, recent evidence: Simmons, Gene. 00341
General
North America and Europe, evidence, age: Rioult, Michel. 06361
Continental margin
California
Shelf, sediments, organic debris: Uchupi, Elazar. 06146
Nova Scotia
Gully submarine canyon, sedimentation patterns: Stanley, Daniel J. 00320
United States
Eastern shelf, sediments, carbonate content: Hulseman, Jobst. 06145
Southeastern, sediments: Goodell, H. Grant. 06358
Continents
Genesis
Popular description: Herrin, Eugene. 06081

Copper
New Mexico
Santa Rita stock, occurrence, genesis: Nielsen, R. L. 06282
Ontario
Sudbury district, Strathcona mine, genesis: Naldrett, A. J. 06044
Core
Composition
Current data, review: Hales, Anton L. 06055
Physical properties
Composition, density, size, recent observations: Simmons, Gene. 00341
Structure
Current data, review: Hales, Anton L. 06055
Cretaceous
Alberta
Central, palynology, Colorado Group: Norris, G. 06034
Waterton gas field, Alberta Group: Herr, R. L. 06103
California
Ben Lomond Mountain area, intrusions: Leo, Gerhard W. 06294
Central, Angiosperms, Panoche Formation: Page, Virginia M. 00345
Contra Costa and Fresno Counties, Foraminifera, orthokarstenids: Graham, Joseph J. 06359
Kern County, Foraminifera, Hex Formation: Church, Clifford C. 00170
Palynology, Moreno Formation: Drugg, W. S. 06100
Central America
Southern, paleogeography: Henningsen, D. 06095
Length of year
Bivalve shell evidence: Berry, William B. N. 00354
New Mexico
Chama quadrangle, stratigraphy: Muehlberger, William R. 06384
North Carolina
Coastal plain, Black Creek Formation: Swift, Donald J. P. 06324
Oklahoma
Palynomorphs, Red Branch Member of Woodbine: Hedlund, Richard W. 06061
Palynomorphs
Ariadnaesporites, distribution, Upper: Hills, L. V. 06063
Ariadnaesporites, Upper, n.spp., Maryland, Montana: Hall, John W. 06062
South Carolina
Coastal plain, Black Creek Formation: Swift, Donald J. P. 06324
Utah
Northeastern, Upper, conformity with Tertiary: Catacosinos, Paul A. 00266
Crust
Colorado
Structure, Rayleigh-wave data: Sherburne, Roger W. 06073
Deformation
Asteroid impact: Cohenour, Robert E. 00371
Crust
General
Popular description: Herrin, Eugene. 06081
New Mexico
Structure, Rayleigh-wave data: Sherburne, Roger W. 06073
Northwest Territories
Structure, Sverdrup basin: Hobson, George D. 06395
Structure
Continental, explosion seismology since 1963: Steinhart, John S. 06424
Crystal chemistry
Garnet
Review: Geller, S. 06071
Muscovite-montmorillonite
Mixed-layer, lattice model, one-dimension: Zen, E-an. 06121
NaCl structure
Vacancy radius, solubility limits, calculation from lattice parameter: Barry, Thomas L. 05997
Nonstoichiometric crystals
Order-disorder, calculation, mistake model: Jagodzinski, Heinz. 05994
Orthopyroxene
Metamorphic and volcanic, Mg^{2+}-Fe^{2+} distribution, site occupancy: Ghose, Subrata. 06070
Spinel
Magnesium-aluminum, diffuse intensities, calculation, mistake model: Jagodzinski, Heinz. 05994
Crystal structure
Analysis
Inversion center detection, Patterson function: Abrahams, S. C. 05996
Andesine
Superlattice maxima, high-temperature diffraction data: Foit, Franklin F., Jr. 05992
Anorthite
Superlattice maxima, high-temperature diffraction data: Foit, Franklin F., Jr. 05992
Clinoamphiboles
Exsolution, metamorphic rocks: Ross, Malcolm. 00177
Clinopyroxene
Nomenclature scheme, diopside-type structures: Burnham, Charles W. 05991
Djurleite
Orthorhombic or pseudo-orthorhombic: Takeda, Hiroshi. 05985
Feldspar
Triclinic, lattice angles, changes at elevated temperature: Grundy, H. D. 06094
Garnet
Review: Geller, S. 06071
Ice
Hexagonal and cubic forms at low temperatures: Kumai, Motoi. 00349

Crystal structure
Muscovite
3*T* form, cf. $2M_1$, Washington: Guven, Necip. 05993
Pectolite
Refinement: Prewitt, C. T. 05995
Pharmacosiderite
Refinement: Buerger, M. J. 05984
Plagioclase
Effect on pericline and albite twinning: Starkey, John. 06028
Crystallography
Methods
Nomenclature scheme, clinopyroxene of diopside-type structure: Burnham, Charles W. 05991
Patterson function, inversion center detection, computer expressions: Abrahams, S. C. 05996
Twinning
Albite, pericline relation to plagioclase structure and composition: Starkey, John. 06028
Pseudohexagonal and pseudotetragonal, djurleite: Takeda, Hiroshi. 06008
Deformation
Experimental studies
Compression, rocks, microfracturing and inelasticity: Scholz, C. H. 00282
Failure, granodiorite, shocked and normal: Giardini, A. A. 00287
Intergranular flow, quartz and quartzite: Heard, Hugh C. 00274
Field studies
Stress, state in sedimentary basin, determination: Currie, J. B. 06251
General
Theory, mechanism, review: Cheatham, J. M., Jr. 06250
Deltas
Construction
Cyclic nature, sand and sandstone facies: Donaldson, Alan C. 06017
Experimental studies
Computer model, coal-bearing: Oertel, G. 06041
Nova Scotia
Minas Basin, proglacial marine: Swift, Donald J. P. 06367
Panama
Rio Parita, Azuera Peninsula, photogeology: Tricart, J. 06076
Devonian
Colorado
Correlation: Baars, D. L. 00181
Colorado Plateau
Correlation: Baars, D. L. 00181
Iowa
Central, La Porte City Chert: Parker, Mary Combs. 06030
Maine
Northern, pteridophytes: Andrews, Henry N. 00362
New Mexico
Correlation: Baars, D. L. 00181
Devonian
Northwest Territories
Ross River region, Pisces, Lower: Jarvik, Erik. 06379
Nova Scotia
Arisaig and Pictou Counties, Pisces, Knoydart Formation: Dineley, D. L. 06386
United States
Eastern, conodonts, Upper: Huddle, John W. 00209
Utah
Northeastern, Pisces, Water Canyon Formation: Denison, Robert H. 06356
Diagenesis
Carbonate mounds
Utah–Colorado, Paradox basin: Peterson, James A. 05987
Experimental studies
Sand–sandstone system, model: Smalley, I. J. 06142
Sandstone
Compaction, cementation, factors, processes: Blatt, Harvey. 05986
Sedimentary rocks
Carbonates, porosity history, determination: Murray, Raymond C. 06014
Effect on porosity and permeability, application in Williston basin: Miller, D. N., Jr. 06015
Differential thermal analysis
Data
Vermiculite, Texas: Kerns, Raymond L., Jr. 06109
Methods
Apparatus, construction, operation, performance: Lake, Richard H. 06151
Dominican Republic
Geochemistry
Orthopyroxene, Mg^{2+}-Fe^{2+} distribution: Ghose, Subrata. 06070
Maps, geologic
General: Blesch, Robert R. 06235
Maps, ground water
General: Blesch, Robert R. 06235
Maps, mineral resources
General: Blesch, Robert R. 06235
Earth
General
Origin and space relations, collected essays: Odishaw, Hugh. 06079
Interior
Density, recalculation from seismic velocities: Howell, B. F., Jr. 06074
Radiative conductivity, thermal history: Aronson, J. R. 06366
Origin
Problems of analysis: MacDonald, Gordon J. F. 06080
Physical properties
Density, recalculation from seismic velocities: Howell, B F., Jr. 06074
Rotation
Rate, Cretaceous, Late: Berry, William B. N. 00354

Earth
Shape
Popular description: Kaula, W. M. 06068
Surface features
Observation from space: Fischer, William A. 00352
Earthquakes
Alaska
June 21, 1967, Fairbanks area: Cloud, William K. 00167
June–July 1967, Fairbanks area, preliminary report: Jordan, James N. 00201
March 28, 1964, effects: Hansen, Wallace R. 06004
March 28, 1964, geomagnetic field effects: Hirshberg, Joan. 00203
March 1964, February 1965, free oscillations and Q values: Nowroozi, A. A. 00273
California
1960, Jan. 19 and April 8, Hollister, seismoscope results: Cloud, William K. 06418
1966, June 27 main shock, Parkfield, seismoscope results: Cloud, William K. 06418
June 1966, Parkfield area, San Andreas fault, errata: Hofmann, R. B. 06075
September 14, 1963, Chittenden area: Brabb, Earl E. 06295
Deep focus
Hypocentral patterns, island arcs: Dennis, John G. 00284
Hypocentral patterns, island arcs: Sykes, Lynn R. 00283
Effects
Dams, earth: Brown, R. L. 00198
Engineering structures, slope stability: Harlan, Richard C. 00197
Free oscillations, measurement of Q: Nowroozi, A. A. 00273
Geomagnetic field, torsional eigenmodes: Hirshberg, Joan. 00203
Experimental studies
Model seismicity, rupture parameters, stress, energy: King, Chi Yu. 00289
Genesis
Solar activity as trigger: Simpson, John F. 00202
Magnitude
Determination, Lg phase technique: Baker, R. G. 06072
Mechanism
Island arcs, deep focus, phase changes: Sykes, Lynn R. 00283
Mexico
Seismicity, Mexico City area, magnitude frequency relation: Ferraes, Sergio G. 00204
Prediction
Microfractures, experimental studies: Scholz, C. H. 00280
Solar flare activity, graphs: Simpson, John F. 00202
Echinoidea
Taxonomy
Oligopygoidea, Eocene, Florida–Caribbean region: Kier, Porter M. 06057
Ecology
Analysis
Substrate, relation of trace elements: Diem, Kenneth L. 06214
Foraminifera
Marine, harbors: Buzas, Martin A. 00169
Education
General
High school and college levels, earth science: Lounsbury, John F. 06039
Materials, color films: Enman, John A. 06037
Elastic properties
Sediments
North Atlantic, Caribbean, sound velocity vs. porosity and grain diameter: Schreiber, B. Charlotte. 00285
Electrical properties
Crystalline rocks
Resistivity changes, fracture and friction sliding: Brace, W. F. 00279
Electrical surveys
Alabama
Heflin area, ground-water prospecting: Joiner, Thomas J. 06376
Colorado
Straight Creek Tunnel, pilot bore: Scott, J. H. 00376
Electron diffraction analysis
Methods
Montmorillonite, bentonitic: Jonas, Edward C. 06119
Electron microscopy
Methods
Montmorillonite, bentonitic: Jonas, Edward C. 06119
Engineering geology
Clays
Kaolinite, viscoelastic shear response, experimental studies: Krizek, Raymond J. 06194
Stability, testing of sensitive: Crawford, C. B. 06059
Stress–strain characteristics, cyclic: Thiers, Gerald R. 00324
Dams
Arizona–Utah, Glen Canyon dam site: Wiegel, Egon. 06096
Degradation below dams, prediction: Peters, John C. 00301
Earth, design, earthquake considerations: Brown, R. L. 00198
Earth, expansive clays, special problems: Satyanarayana, B. 00199
Ohio, Licking River basin, Utica site: U.S. Army Corps Engineers. 06276
River-bed degradation below, prediction: deVries, M. 00303
River-bed degradation below, prediction: Egiazaroff, Ivan. 00304
River-bed degradation below, prediction: Gill, Mohammad Akram. 00302

Engineering geology
Dams
River-bed degradation below, prediction: Herbertson, John G. 00300
Earthquakes
Alaska, Fairbanks area, June 21, 1967: Cloud, William K. 00167
Dam design, earth: Brown, R. L. 00198
Slope stability, earth dam: Harlan, Richard C. 00197
Foundations
California, Central Valley, Dos Amigos Pumping Plant, rebound: Stoll, Ulrich W. 00200
Landslides
Prediction, acoustical monitoring: Cadman, John D. 06322
Quebec, Toulnustouc River, sensitive clay: Crawford, C. B. 06059
Materials, properties
California, central, subsiding areas, sediments: Johnson, A. I. 00312
Sewer project studies: Greer, David M. 00210
Permafrost
Experimental studies, clay suspensions, pressure melting, conductance: Hoekstra, P. 06193
General: Prince, Paul A. 06038
Practice
1966, geophysical projects, world: Tucker, L. R. 00185
Rivers
Hydraulic problems, interdisciplinary approach: Simons, Daryl B. 06164
Mississippi River, Vicksburg District, control criteria: Anding, Malcolm G. 06163
Scour by free falling water, soils and rock: Mirtskhulava, Ts. E. 06157
Rock mechanics
Application, hydraulic fracturing theory: Perkins, T. K. 06253
Deformation and failure, methods, review: Cheatham, J. M., Jr. 06250
Failure in bore-hole drilling: Simon, R. 06252
Nevada Test Site, granodiorite, failure: Giardini, A. A. 00287
Sedimentary rocks, stress state, measurement: Currie, J. B. 06251
Seepage
Water storage areas, surface erosion: Rahm, S. Lennart. 06156
Slope stability
Earthquake effects: Harlan, Richard C. 00197
Mississippi River, Vicksburg area, bank scour: Franco, John J. 06170
Special problems: Satyanarayana, B. 00199
Soils
Frost susceptibility, particle size as basis for assessing: Penner, E. 06056
Sewer project studies: Greer, David M. 00210
Tunnels
Colorado, Straight Creek pilot bore, construction parameters: Scott, J. H. 00376

Engineering geology
Waste disposal
New York, Long Island, Bay Park area, injection wells, salt-water barrier: Cohen, Philip. 06129
Subsurface, industrial, progress report: Eddy, Gerald E. 06065
Water reclamation, ground-water recharge, economics: Frankel, Richard J. 06133

Erosion
Streams
Degradation below dams, prediction: deVries, M. 00303
Degradation below dams, prediction: Egiazaroff, Ivan. 00304
Degradation below dams, prediction: Gill, Mohammad Akram. 00302
Degradation below dams, prediction: Herbertson, John G. 00300
Degradation below dams, prediction: Peters, John C. 00301
Soils and rock beds, free-falling water: Mirtskhulava, Ts. E. 06157

Evolution
Invertebrata
Hard-shelled, relation to lunar tides in Cambrian: Lamar, D. L. 06006
Paleozoic, marine communities, rate: Bretsky, Peter W. 00178
Pisces
Osteichthyes, Devonian-Recent, vertebrae: Schaeffer, Bobb. 06380
Pteridophytes
Sporangia structure, Paleozoic: Eggert, Donald A. 06101
Radiolaria
Acceleration, effect of magnetic field reversals: Opdyke, N. D. 05983

Faults
Overthrust
Nevada, Ruby Mountains, absolute age: Willden, Ronald. 05981
Strike-slip
Alaska, Denali and Slate Creek faults, Alaska Range: Rose, Arthur W. 06314
California, San Andreas, movement, June 1966, errata: Hofmann, R. B. 06075

Florida
Geochemistry
Trace elements in soil, relation to disease: Harris, Henry C. 06216
Geomorphology
Saint Joseph Spit, sedimentation, wave energy and drift rate: Tanner, William F. 06154
Hydrogeology
Miami area, Biscayne aquifer, storm recharge, salt-front stabilization: Kohout, F. A. 06131
Paleontology
Echinoidea, Eocene, oligopygoids, revision: Kier, Porter M. 06057
Foraminifera, Miocene, Chipola Formation: Seiglie, George A. 00337

Fluid inclusions
Fluorite–zinc
Illinois, Hicks Dome deposits: Hall, W. E. 06278
Fluorine
Abundance
Ground water, United States: Fleischer, Michael. 06220
Fluorspar
Illinois
Hicks Dome deposits, genesis: Hall, W. E. 06278
Tennessee
Center Hill Dam quadrangle, occurrence: Wilson, Charles W., Jr. 06206
Folds
Isoclinal
Recumbent, South Carolina, Piedmont: Griffin, Villard S., Jr. 06046
Foraminifera
Bibliography
Recent literature, annotated: Todd, Ruth. 00338
Cretaceous
California, Hex Formation, Kern County: Church, Clifford C. 00170
Geographic distribution
Massachusetts, Hadley Harbor, controls: Buzas, Martin A. 00169
Orthokarstenia
Cretaceous, California, type species, restudy: Graham, Joseph J. 06359
Reichelinella
Miocene, Florida, Chipola Formation, description, synonymy: Seiglie, George A. 00337
Siphogenerinoides
Cretaceous, California, orthokarstenid synonyms: Graham, Joseph J. 06359
Tertiary
California, San Juan Bautista Formation, Eocene: Waters, J. N. 00329
Fractures
Experimental studies
Microfractures, granite, earthquake prediction: Scholz, C. H. 00280
Gas, natural
Alaska
Cook Island Inlet basin: Osment, F. C. 06404
Exploration
Gulf of Mexico, history: Blattner, S. D. 06451
Genesis
Hydrocarbons of low molecular weight, geochemical origin: Erdman, J. Gordon. 06434
Geochemistry
Hydrocarbons, low molecular weight, genesis: Erdman, J. Gordon. 06434
Kentucky
Redbush quadrangle, occurrence: Rice, Charles L. 00335
Mexico
Exploration, production, 1863–1966: Cervera, Eduardo. 06443
Gas, natural
Prince Edward Island
Possibilities: Williams, E. P. 06365
Reserves
World, ultimate and proved: Ion, D. C. 06445
Gems
Perlite
Mexico, Sonora, Alamos area, peanut obsidian: Broughton, Paul L. 00358
General
Education
Earth science, high school and college levels: Lounsbury, John F. 06039
Materials, color films: Enman, John A. 06037
Methods
Natural science, inquiry, logic: Nielsen, H. A. 06128
Practice
Automatic data processing, storage and retrieval systems: Dillon, E. L. 06452
Nutrition, relation to geology and trace elements: Cannon, Helen L. 06211
Review articles
Bibliography: Hawkes, H. E. 06377
Textbooks
Metamorphic rocks, mineralogical–chemical aspects: Winkler, Helmut G. F. 06402
Soil formation and classification, selected papers: Drew, J. V. 06382
Geochemical surveys
Alaska
Copper, lead, zinc, river sediments, upper Chistochina River area: Rose, Arthur W. 06314
Trace elements, Seward Peninsula, western: Sainsbury, C. L. 06362
California
Lakeview Mountain Tonalite, variability, field sampling test: Baird, A. K. 06389
Colorado
Metals, Summitville mining district: Sharp, William N. 00355
United States
Metallic elements, rivers, suspended sediments, western cf. eastern: Turekian, Karl K. 06414
Geochemistry
Abundance of elements
Crust, correlation with epidemiology: Warren, Harry V. 06212
Relation to nutrition: Diem, Kenneth L. 06214
Selenium, relation to disease in cattle: Allaway, W. H. 06215
Trace, relation to cardiovascular diseases, problems: Banta, James E. 06213
Trace relation to nutrition, Florida: Harris, Henry C. 06216
Aragonite
Transformation from vaterite, common ion effect: Bischoff, J. L. 00278
Calcite
Transformation from aragonite, common ion effect: Bischoff, J. L. 00277

Geochemistry
Exchange capacity
Montmorillonite: Bolt, G. H. 06311
Montmorillonite: Kemper, W. D. 06315
Ground water
Reaction with recharge water: Warner, D. L. 06132
Mantle
Solid solution equilibria, olivine–spinel: Akimoto, Syun-iti. 00281
Marine sediments
Alkali metals, terrestrial fractionation, ocean-water evolution: Harriss, Robert C. 06204
Metals
Alkali, ocean waters, evolution, continental drainage control: Harriss, Robert C. 06204
Methods
Sediments, gases in interstitial water: Reeburgh, William S. 00359
Natural waters
Equilibrium, relation to biological activity: Lee, G. Fred. 06413
Processes
Ion exchange, feldspar, recognition: Rimsaite, J. 06026
Sea water
Heterogeneous equilibria, of major and minor constituents: Schindler, Paul W. 06417
Sediments
Gases in interstitial water, measurement technique: Reeburgh, William S. 00359
Soils
Uranium and thorium, distributions: Hansen, R. O. 00343
Solubility
NaCl crystal, calculation from lattice parameter: Barry, Thomas L. 05997
Radiolarian skeletons, solution rate at depths: Berger, Wolfgang H. 00309
Silica minerals, aqueous suspensions, silicic acid formation: Stober, Werner. 06416
Geochronology
Hydration of glass
Obsidian, California, Glass Mtn. rhyolite flows: Friedman, Irving. 00171
Paleomagnetism
Deep-sea sediments, reversals, cf. dated lavas: Opdyke, N. D. 05983
Geodesy
Figure of Earth
Determination methods, popular description: Kaula, W. M. 06068
Geologic thermometry
Orthopyroxene
Mg^{2+}–Fe^{2+} distribution: Ghose, Subrata. 06070
Geological exploration
Methods
Infrared mapping: VanLopik, Jack. 00351
Models, predictive, stratigraphic traps: Moore, Peter Gerald. 06455
Geomorphology
Eolian features
Dunes, Colorado, southern: Johnson, Ross B. 00180
Geomorphology
Eolian features
Transport, Nova Scotia, Sable Island: James, Noel P. 06058
Fluvial features
Gravel bed forms, Alberta, North Saskatchewan River: Galay, V. J. 06159
Meander systems, planforms, spectral analysis: Toebes, G. H. 06172
Meanders, development, model study: Anderson, Alvin G. 06160
Meanders, genesis: Adachi, Shohei. 06171
Rivers, hydraulic engineering, interdisciplinary approach: Simons, Daryl B. 06164
Transport, bed forms, sand waves, Columbia River: Whetten, John T. 06310
Transport, bed roughness: Blench, T. 06173
Transport, bed roughness: Kikkawa, Hideo. 06174
Glacial features
General, Connecticut, Hartford South quadrangle: Deane, R. E. 06097
Interpretation, Yukon, Glenlyon map area: Campbell, R. B. 06319
Moraines, Alaska, Chagvan Bay area: Porter, Stephen C. 06052
Outwash, fluviomarine, Nova Scotia: Swift, Donald J. P. 06367
Landform description
Alaska, Mendenhall Valley: Barnwell, William W. 00373
Glacial features, North Dakota, Eddy and Foster Counties, popular account: Bluemle, John P. 06383
New Mexico, Dona Ana County: Ruhe, Robert V. 06385
Quebec, Saint Gabriel de Brandon area, drainage patterns: Beland, Rene. 06023
Landform evolution
Arizona, San Francisco Mtn. Volcanic Field: Colton, Harold S. 06308
Methods
Photography, beach changes: Dolan, Robert. 06408
Periglacial features
Glossary, illustrated: Hamelin, Louis-Edmond. 06309
Shore features
Transport, Nova Scotia, Sable Island: James, Noel P. 06058
Geophysical surveys
World
1966, engineering and ground-water projects: Tucker, L. R. 00185
Geophysics
Research
Significant contributions, recent highlights: Simmons, Gene. 00341
Georgia
Sedimentary petrology
Barrier islands, high-angle stratification, Recent: Hoyt, John H. 06148

Geosynclines
Terminology
Historical changes: Kay, Marshall. 06049
Glaciers
Ice
Composition, oxygen isotopes, microparticles, Greenland: Hamilton, W. L. 00321
Glossaries
Periglacial phenomena
Illustrated: Hamelin, Louis-Edmond. 06309
Gold
Alaska
Upper Chistochina River area, occurrence: Rose, Arthur W. 06314
Geochemistry
Meteorites, nodules, phlogopite, concentrations: Linn, T. A., Jr. 00205
Nevada
Carlin area, Lynn mining district, genesis: Hausen, D. M. 06279
Cortez area, Roberts Mts. thrust plate, occurrence: Wells, J. D. 06274
North central, occurrence: Roberts, R. J. 06397
North America
Reserves: Kavanagh, Paul M. 05998
Resources
Worldwide: Kavanagh, Paul M. 05998
Graptolithina
Psigraptus arcticus, n.gen., n.sp.
Ordovician, Yukon, Lower: Jackson, D. E. 06050
Gravel
Tennessee
Chewalla quadrangle, occurrence: Larson, Lawrence T. 06207
Pine View quadrangle, occurrence: Wilson, Charles W., Jr. 06225
Gravity methods
Instruments
Gravimeters, borehole, precise: McCulloh, Thane H. 06449
Techniques
Borehole, developments and applications: McCulloh, Thane H. 06449
Shipborne: Loncarevic, B. D. 06401
Gravity surveys
Canada
Gulf of Saint Lawrence region, Orpheus anomaly: Loncarevic, B. D. 06401
Utah
Wasatch trench area, northern: Cook, Kenneth L. 06289
Greenland
Geochemistry
Ice core, oxygen isotopes, ratios, microparticle correlation: Hamilton, W. L. 00321
Orthopyroxene, Mg^{2+} Fe^{2+} distribution: Ghose, Subrata. 06070
Maps, geologic
Skaergaard intrusion: Wager, L. R. 00366
Paleontology
Amphibia, Triassic, Kap Stosch, skull morphology: Nielsen, Eigil. 06381
Greenland
Petrology
Ilimaussaq intrusion, lujavrites, hydrothermal veins: Sorensen, Henning. 06275
Skaergaard intrusion, layering, crystal fractionation: Wager, L. R. 00366
Ground water
Alabama
Exploration, geophysical, Heflin area: Joiner, Thomas J. 06376
Arkansas
Recharge, Grand Prairie region, artificial, aquifer and well characteristics: Johnson, A. I. 06125
California
Model study, Los Angeles basin: Chun, Robert Y. D. 06106
Resources, development, integration with surface water: Johnson, Thelma A. 0611
Florida
Salt water intrusion, Miami area, Biscayne aquifer, storm recharge effects: Kohout, F. A. 06131
Hawaii
Resources, Honolulu-Pearl Harbor area: Lau, L. S. 06114
Illinois
Recharge, artificial, potential: Smith, H. F. 06138
Iowa
Movement, east-central, Four Mile Creek base flow: Kunkle, George R. 00375
Resources, Decatur County: Cagle, J. W. 06292
Kansas
Resources, Brown County: Bayne, Charles K. 05980
Louisiana
Resources, Lake Pontchartrain basin: Cardwell, G. T. 06392
Michigan
Recharge, Kalamazoo area, artificial, induced interaquifer leakage: Deutsch, Morris. 06124
New Hampshire
Resources, Merrimack River valley, lower: Weigle, James M. 00322
New Jersey
Recharge, Princeton area, artificial: DeWiest, Roger J. M. 06137
New Mexico
Resources, Arkansas River basin, aquifer properties, analyses: Ballance, W. C. 0640
Resources, central, closed basins: Titus, Frank B., Jr. 06441
Resources, Lower Colorado River sub-basins: Trauger, Frederick D. 06407
Resources, occurrence, development, uses: New Mexico State Engineer Office. 0644
Resources, Pecos River basin: Mourant, Walter A. 06440
Resources, Rio Grande basin: Dinwiddie, George A. 06406
Resources, San Juan River basin: Cooper, James B. 06432

Ground water
New Mexico
Resources, Southern High Plains: Ballance, W. C. 06439
Resources, southwestern, Basin and Range section: Doty, Gene C. 06428
New York
Salt-water intrusion, Long Island, Bay Park area, injection well barrier: Cohen, Philip. 06129
Texas
Resources, water plan: Peckham, Richard C. 00196
United States
Resources, research needs: McGuinness, C. L. 06378
Gulf of Mexico
Economic geology
Petroleum, natural gas, exploration, history: Blattner, S. D. 06451
Paleontology
Protista, Tertiary, coccolithophores, Sigsbee knolls: Gartner, Stefan, Jr. 06011
Protista, Tertiary, coccolithophores, Sigsbee knolls: Gartner, Stefan, Jr. 06012
Sedimentary petrology
Sediments, microstructure: Bowles, Frederick A. 00179
Hawaii
Hydrogeology
Honolulu Pearl Harbor area, ground water resources: Lau, L. S. 06114
Heat flow
Heat sources
California, Sierra Nevada batholith, radioactivity, and age relations: Wollenberg, Harold A. 00271
Measurement
Infrared surveys: VanLopik, Jack. 00351
Heavy minerals
Exploration
Separation and identification techniques: Stone, Jerome. 00370
Kansas
Neosho River valley, Pleistocene deposits: Jamkhindikar, Suresh. 06002
History
International Geological Congress
Founding committee, 1876, U.S.A.: Thurston, William. 00340
Hydrogeology
Automatic data processing
Aquifer management, analysis techniques: Bittinger, M. W. 06115
Geochemistry
Ground water, reaction with recharge water: Warner, D. L. 06132
Natural waters, equilibrium, relation to biological activity: Lee, G. Fred. 06413
Ground water contamination
Nitrate poisoning: Keller, W. D. 06218
Ground water movement
Aquifers, unconfined and confined, comparison: Kriz, George J. 00268
Barrier, air: Roberts, George D. 06136
Hydrogeology
Ground water movement
Saline aquifer, recharge with fresh water, quality change: Maasland, D. E. L. 06134
Seepage flow, Pavlovsky's solution, computer program: Papadopoulos, George T. 00194
Soils, I-131 tracer: Hamid, A. 06178
Unconfined aquifers, recharge wells, radial flow, numerical solutions: Esmaili, Houshang. 00195
Vertical hydraulic conductivity, measurement: Bouwer, Herman. 06130
Ground water recharge
Treated wastes, economics: Frankel, Richard J. 06133
Hydrodynamics
Application, petroleum exploration: Hubbert, M. King. 06403
Vertical hydraulic conductivity, measurement: Bouwer, Herman. 06130
Mathematical models
Aquifer management: Bittinger, M. W. 06115
Ground water basins: Chun, Robert Y. D. 06106
Methods
Geophysical, ground-water projects, world, 1966: Tucker, L. R. 00185
Instruments, hygrometer for soil water: Bouyoucos, George J. 06179
Vertical hydraulic conductivity, measurement: Bouwer, Herman. 06130
Resource development
Ground-water research, United States: McGuinness, C. L. 06378
New Mexico, urban, rural-domestic, and industrial: New Mexico State Engineer Office. 06442
River hydraulics, interdisciplinary approach: Simons, Daryl B. 06164
Salt-water intrusion
Barrier, air: Roberts, George D. 06136
Barrier canal, fresh water: Charmonman, Srisakdi. 06135
Barrier wells, New York, Long Island: Cohen, Philip. 06129
Hydrothermal alteration
Phase relations
Sphalerite replacement of limestone: Holland, H. D. 06280
Process
Epigenetic mineral deposits, wallrock diffusion: Boyle, R. W. 06284
Metals and gangue elements, country-rock sources: Boyle, R. W. 06285
Wyoming
Bedrock, sediments, Yellowstone Natl. Park, argillic, sequence: Droste, John B. 06271
Ice, nonglacial
Behavior in soils
Lenses, formation, unidirectional freezing, heaving pressure: Penner, E. 06056
Experimental studies
Crystal structure at low temperatures: Kumai, Motoi. 00349

Ice, nonglacial
Experimental studies
Growth, preferred orientation: Ketcham, W. M. 06269
Idaho
Stratigraphy
Precambrian, Great Basin: Condie, Kent C. 06355
Igneous rocks
Basalt
Extrusive, forms and structure: Macdonald, Gordon A. 06247
General description, Washington, Yakima Basalt, upper flows: Schmincke, Hans Ulrich. 06019
Geochemistry, silicate systems in magma, experimental: Yagi, Kenzo. 06243
Intrusive, forms and structures: Frankel, J. J. 06248
Mineralogy, in crystallizing magma: Brown, G. M. 06237
Petrology, collected papers: Hess, H. H. 06245
Basaltic
Alteration, high pressure effects: Green, D. H. 06239
Classification, petrography, relation to magma type: Wilkinson, J. F. G. 06238
Geochemistry, chemical definition, by major element variations: Manson, Vincent. 06240
Geochemistry, chemical definition, by trace element variations: Prinz, Martin. 06241
Carbonatite
Magnetic anomalies, Ontario, complexes: Satterly, J. 00347
Composition
California, Tuscan Buttes, andesite, cf. Tuscan Formation breccia: Lydon, Philip A. 06387
Mean atomic weight, cf. Earth and planets: Anderson, Don L. 06411
Differentiation
Basalt and andesite, experimental: Green, Trevor H. 00166
Layered intrusions, Greenland, Skaergaard, and others: Wager, L. R. 00366
Potassic rocks, phase relations, experimental studies: Luth, W. C. 06043
Eclogite
Composition, lanthanide: Masuda, Akimasa. 06423
General
General description, Iowa, basement complex: Yoho, W. Herbert. 06031
General description, Washington, Lake Tapps quadrangle: Gard, Leonard M., Jr. 00313
Geochemistry
Alaska, Seward Peninsula, western, trace elements, analyses: Sainsbury C. L. 06362
Zircon, relation to P T conditions: Dietrich, R. V. 00330
Granite
Genesis, history of theories: Marmo, Vladimir. 06422
Physical properties, resistivity changes during fracture: Brace, W. F. 00279
Igneous rocks
Granitic
Composition, reclassification, California, Yosemite Valley, intrusives: Smith, Arthur R. 06360
Composition, Yukon, Glenlyon map-area, modal analyses: Campbell, R. B. 06319
Granodiorite
Strength, triaxial compression, nuclear and mechanically shocked, vs. normal: Giardini, A. A. 00287
Ignimbrite
General description, Quebec, Chandler—Port-Daniel area: Ayrton, W. G. 06326
Textures, fiamme, genesis: McBirney, Alexander R. 00353
Mafic
Absolute age, Minnesota, Granite Falls area: Hanson, G. N. 06018
Melting
Potassic rocks, phase relations, experimental studies: Luth, W. C. 06043
Mineral facies
Quebec, Belleau–Desaulniers area, Precambrian: Philpotts, A. R. 06099
Orbiculite
Petrology, Washington, Jove Peak: VanDiver, Bradford B. 00275
Pegmatite
General description, North Carolina, Blue Ridge: Lesure, Frank G. 00261
Peridotite
Composition, phlogopite, stability, upper mantle: Kushiro, I. 06412
General description, Quebec, Chandler—Port-Daniel area: Ayrton, W. G. 06326
Quartz diorite
Geochemistry, California, Lakeview Mtn. Tonalite, sampling test: Baird, A. K. 06389
Quartz monzonite
General description, California, Salt Spring Hills: Troxel, Bennie W. 06357
Rhyolite
Absolute age, California, hydration of obsidian: Friedman, Irving. 00171
Absolute age, California, Mono, Inyo Craters: Dalrymple, G. Brent. 00326
Absolute age, California, Mono, Inyo Craters: Taddeucci, Adriano. 00315
Volcanics
Alteration, Nevada, West Humboldt Range: Wones, David R. 06027
General description, California, Tehama County: Lydon, Philip A. 06387
General description, Colorado, Powderhorn, Black Canyon region: Olson, J. C. 00374
Geochemistry, isotope compositions, relation to mantle: Gast, Paul W. 06242
Illinois
Economic geology
Fluorite–zinc, Hicks Dome deposits, genesis: Hall, W. E. 06278

Illinois
Geochemistry
Hicks Dome fluorite zinc deposits, fluid inclusions, isotopes: Hall, W. E. 06278
Hydrogeology
Aquifer recharge, artificial, potential: Smith, H. F. 06138
Paleontology
Pteridophytes, Pennsylvanian, Berryville coal, Berryville area: Eggert, Donald A. 06101
Inclusions
Phlogopite
Gold content: Linn, T. A., Jr. 00205
Indiana
Geomorphology
Western, Wabash River, point bars, biogenic directional features: Pryor, Wayne A. 06325
White River system, meander planforms, spectral analysis: Toebes, G. H. 06172
Infrared methods
Applications
Geoscience problems: VanLopik, Jack. 00351
Insecta
Cotradechites lithinus, n.gen., n.sp.
Paleocene, upper, North Dakota, Dickinson area: Fennah, R. G. 00325
Intrusions
Basaltic
Forms and structures: Frankel, J. J. 06248
Layered
Crystal fractionation in magmas, various examples: Wager, L. R. 00366
Plugs
California, Tuscan Buttes: Lydon, Philip A. 06387
Plutons
California, Ben Lomond Mtn. area: Leo, Gerhard W. 06294
Nova Scotia, Shelburne map area: Taylor, F. C. 06318
Petrology, California, Yosemite Valley, granitic units: Smith, Arthur R. 06360
Invertebrata
Cambrian
Evolution, hard shell, relation to lunar tides: Lamar, D. L. 06006
Paleozoic
Evolution of marine communities: Bretsky, Peter W. 00178
Iowa
Hydrogeology
Decatur County, ground water resources: Cagle, J. W. 06292
East central, Four Mile Creek, base flow, reservoir contributions: Kunkle, George R. 00375
Maps, ground water
East central, Four Mile Creek basin: Kunkle, George R. 00375
Petrology
Basement complex, crystalline rock types, bottom hole samples: Yoho, W. Herbert. 06031
Iowa
Stratigraphy
Cambrian–Permian, Forest City basin: Anderson, K. H. 00265
Devonian, La Porte City Chert, central, new: Parker, Mary Combs. 06030
Pennsylvanian, Altamont Limestone, cyclothem: Schenk, Paul E. 06005
Structural geology
Forest City basin, history: Anderson, K. H. 00265
Iron
Canada
Eastern, Appalachian and Grenville regions, occurrence: Gross, G. A. 06296
Geochemistry
Igneous and sedimentary rocks, cf. Sc and rare earths: Norman, Jack C. 00293
Oil shale, ratio to Ni: Houghton, A. Sherrill. 06260
Quebec
Gras Lake–Felix Lake area, Proterozoic iron formation, potential: Clarke, P. J. 06024
Isostasy
Compensation
Popular description: Herrin, Eugene. 06081
Isotopes
Carbon
Fractionation, calcareous marine invertebrates: Weber, Jon N. 00299
Marine shells, C-14 content: Taylor, R. E. 06233
Shells, composition, equilibrium with environment: Mook, W. G. 00173
Fractionation
Bacterial reduction, sulfate and sulfite: Kemp, A. L. W. 00270
Carbon, oxygen, calcareous marine invertebrates: Weber, Jon N. 00299
Hydrogen
Tritium, meteorites, loss by solar wind hydrogen: Wagener, K. 06364
Lead
Rocks, abundance, concordia plots: Russell, R. D. 00372
Standard samples, ratios: Catanzaro, E. J. 00317
Lithium
Holbrook meteorite, ratios, distribution: Gradsztajn, Eli. 00212
Meteorites
Pu 244 fission tracks, cooling rate: Fleischer, R. L. 00298
Tritium loss by solar wind hydrogen: Wagener, K. 06364
Oxygen
Greenland Icecap, core, ratios: Hamilton, W. L. 00321
Shells, equilibrium with environment: Mook, W. G. 00173
Plutonium
Meteorites, Pu 244 fission tracks: Fleischer, R. L. 00298

Isotopes
Sulfur
Sulfate and sulfite, fractionation, bacterial reduction: Kemp, A. L. W. 00270
Volcanic rocks
Fractionation, relation to mantle composition: Gast, Paul W. 06242
Xenon
Meteorites, sources in achondrites: Munk, Miner N. 00206
Jamaica
Geomorphology
Offshore, dwarf atolls, genesis: Burke, Kevin. 00267
Paleontology
Protista, Miocene, San San Clay, coccolithophores: Gartner, Stefan, Jr. 06012
Kansas
Hydrogeology
Brown County, ground-water resources: Bayne, Charles K. 05980
Maps, geologic
Brown County: Bayne, Charles K. 05980
Maps, isopach
South-central, Kanwaka Shale and members: Brown, Sally Liggett. 06001
Mineralogy
Clay and heavy minerals, Neosho River valley, Pleistocene deposits: Jamkhindikar, Suresh. 06002
Sedimentary petrology
Neosho River valley, Pleistocene terraces and flood-plain deposits: Jamkhindikar, Suresh. 06002
South-central, Elgin sandstone, bar-finger sands: Brown, Sally Liggett. 06001
Stratigraphy
Cambrian-Permian, Forest City basin: Anderson, K. H. 00265
Pennsylvanian, Kanwaka Shale, Elgin sandstone, south-central: Brown, Sally Liggett. 06001
Pennsylvanian-Permian, Quaternary, Brown County: Bayne, Charles K. 05980
Structural geology
Forest City basin, history: Anderson, K. H. 00265
Kentucky
Economic geology
Mineral resources, Clintonville quadrangle: MacQuown, W. C., Jr. 00269
Petroleum and natural gas, Redbush quadrangle, occurrence: Rice, Charles L. 00335
Petroleum, Quality quadrangle, occurrence: Gildersleeve, Benjamin. 00334
Maps, geologic
Clintonville quadrangle: MacQuown, W. C., Jr. 00269
Quality quadrangle: Gildersleeve, Benjamin. 00334
Redbush quadrangle: Rice, Charles L. 00335
Kentucky
Paleontology
Vertebrata, Pleistocene, Big Bone Lick and general: Jillson, Willard Rouse. 00367
Stratigraphy
Carboniferous, Quaternary, Quality quadrangle, section: Gildersleeve, Benjamin. 00334
Ordovician, Quaternary, Clintonville quadrangle, section: MacQuown, W. C., Jr. 00269
Pennsylvanian, Quaternary, Redbush quadrangle, section: Rice, Charles L. 00335
Krypton
Geochemistry
Chondritic meteorites, unequilibrated, analyses: Heymann, D. 00297
Lakes
Sediments
Palynology, contamination, fossil record disturbance: Nichols, Harvey. 06060
Lakes, extinct
Connecticut
Hartford South quadrangle, glacial Lake Hitchcock: Deane, R. E. 06097
Lanthanum
Abundance
Garnet and pyroxene in eclogite: Masuda, Akimasa. 06423
Geochemistry
Garnet, pyroxene, chemical bond with oxygen: Masuda, Akimasa. 06423
Lava
General
Flow forms, structures: Macdonald, Gordon A. 06247
Lead
Isotopes
Ratios, standard samples: Catanzaro, E. J. 00317
U-238/Pb-204, abundance in rocks, concordia plots: Russell, R. D. 00372
Northwest Territories
Pine Point area, genesis: Folinsbee, R. E. 06286
Limestone
Tennessee
Beans Creek quadrangle, occurrence: Ferguson, Carl C. 06209
Center Hill Dam quadrangle, occurrence: Wilson, Charles W., Jr. 06206
Linden quadrangle, occurrence: Wilson, Charles W., Jr. 06205
Pulaski quadrangle, occurrence: Hershey, Robert E. 06210
Lithium
Isotopes
Ratios, Holbrook meteorite: Gradsztajn, Eli. 00212
Louisiana
Engineering geology
River control, Vicksburg District: Anding, Malcolm G. 06163

Louisiana
Hydrogeology
Lake Pontchartrain basin, Gulf Coastal Plain sediments, water resources: Cardwell, G. T. 06392
Stratigraphy
Oligocene(?), Frio Formation, Hackberry wedge, southwestern: Paine, William R. 00305

Magmas
Differentiation
Basalt, mineralogy: Brown, G. M. 06237
Layered intrusions, Greenland, Skaergaard, and others: Wager, L. R. 00366
Potassic, phase relations, experimental studies: Luth, W. C. 06043
Quartz monzonite, New Mexico, Santa Rita area: Nielsen, R. L. 06282
Experimental studies
Equilibrium diagrams, basalt type: Yagi, Kenzo. 06243
Geochemistry, basaltic, fractional crystallization: Hamilton, D. L. 06231
Granitic glass and aqueous phase, equilibrium melt compositions: Gammon, J. B. 06396
Quartz–feldspar containing, differentiation paths: Stewart, David B. 06025
Zircon crystallization, diverse P–T conditions: Dietrich, R. V. 00330
Geochemistry
Basalt, mineral compositions, crystallization sequence: Brown, G. M. 06237

Magnetic field, Earth
General
Causes, paleoform, popular description: Elsasser, Walter M. 06066
Intensity
Precambrian to present: Carmichael, C. M. 00319
Magnetosphere
Popular description: Axford, W. I. 06067
Observations
Earthquake effects, 1964: Hirshberg, Joan. 00203

Magnetic methods
Dual-level airborne
Application, petroleum exploration: Jenny, W. P. 00363
Instruments
Ship-based helicopter survey, experimental, Canada: Sawatzky, P. 06316
Techniques
Ship-based helicopter survey, experimental, Canada: Sawatzky, P. 06316

Magnetic properties
Coal
Susceptibility, variation with rank: Bivins, Doris. 00377
Silt
Susceptibility to Earth field: Hamilton, N. 06371

Magnetic surveys
Canada
Bay of Fundy, airborne, ship-based helicopter experiment: Sawatzky, P. 06316
Nevada
Dixie Valley, interpretation: Smith, Thomas E. 00288
Ontario
Operation Kapuskasing area, airborne: George, P. T. 06093
South Carolina
York County, Carroll and Ross sulfide prospect: Geyer, Vernon R., Jr. 06047

Maine
Marine geology
Possibilities for development: Beck, Frederick M. 06298
Mineralogy
Rumford area, Black Mtn. pegmatite quarries: Gregory, Gardiner E. 00365
Paleoatology
Pteridophytes, Devonian, Trout Valley Formation, psilophyte, n.sp.: Andrews, Henry N. 00362

Major-element analyses
Basaltic rocks
Variations: Manson, Vincent. 06240
Vermiculite
Texas, Llano County: Kerns, Raymond L., Jr. 06109
Volcanics
Colorado, Powderhorn–Black Canyon region: Olson, J. C. 00374

Mammalia
Taxonomy
Copemys, Democricetedon, Tertiary: Fahlbusch, Volker. 06415
Toxotherium woodi
Oligocene, Texas, Capote Mountain Tuff, Ash Springs: Harris, John M. 06032

Man, fossil
Quaternary
North America, Great Plains, history: Reider, Richard G. 00259

Mantle
Composition
Current data, review: Hales, Anton L. 06055
Elastic waves
Refracted, velocity, curvature correction: Mereu, R. F. 00207
Experimental studies
Composition, phlogopite-bearing peridotite, upper: Kushiro, I. 06412
Olivine-spinel transition, depth, temperature: Akimoto, Syun-iti. 00281
Processes
Phase changes, relation to earthquake hypocentral patterns: Dennis, John G. 00284
Phase changes, relation to earthquake hypocentral patterns: Sykes, Lynn R. 00283
Structure
Current data, review: Hales, Anton L. 06055

Marine geology
Caribbean Sea
Jamaica area, dwarf atolls, genesis: Burke, Kevin. 00267
Continental margin
Nova Scotia, Gully submarine canyon, sediments: Stanley, Daniel J. 00320
Instruments
Deep-ocean sub-bottom profiling, seismic: Waugh, Harry. 06302
Profiling projector, microrelief measurement: Briggs, Robert O. 06300
Mineral exploration
Shipboard computer system: Schneidewind, N. F. 06301
Sediments
Atlantic Ocean, Great Bahama Bank, gelatinous mat: Bathurst, R. G. C. 06370
Continental shelf, California, organic debris: Uchupi, Elazar. 06146
Continental shelf, eastern U.S., carbonate content: Hulseman, Jobst. 06145
North Atlantic and Caribbean, sound velocity: Schreiber, B. Charlotte. 00285
Submarine canyons, sedimentation patterns: Stanley, Daniel J. 00320
United States, continental shelf: Goodell, H. Grant. 06358
Structure
Midoceanic ridges, Atlantic, tectonics, geology, geophysics: VanAndel, Tjeerd H. 00286

Maryland
Maps, geologic
Piedmont, eastern: Southwick, David L. 06327
Paleontology
Palynomorphs, Cretaceous, Magothy Formation: Hall, John W. 06062
Stratigraphy
Precambrian, Glenarm Series, nomenclature, revision: Southwick, David L. 06327

Mesozoic
Yukon
Glenlyon map area, stratigraphy: Campbell, R. B. 06319

Metals
Colorado
Summitville mining district, exploration: Sharp, William N. 00355
United States
Heavy, U.S. Geol. Survey program 1966-67: U.S. Geological Survey. 00356

Metamorphic rocks
Fabric
Connecticut, Waterbury quadrangle, Waterbury and Hartland Formations: Gates, Robert M. 06098
General
General description, Iowa, basement complex: Yoho, W. Herbert. 06031
Textbook, mineralogical-chemical aspects: Winkler, Helmut G. F. 06402

Metamorphic rocks
Geochemistry
Alaska, Seward Peninsula, western, trace elements, analyses: Sainsbury, C. L. 06362
Minnesota, Ely Greenstone, K–Rb ratios in amphiboles: Griffin, W. L. 00316
Gneiss
Geochemistry, Fe, Mn valence equilibria, California: Smith, Douglas. 06105
Mineral composition, Minnesota, Granite Falls–Montevideo area: Himmelberg, G. R. 06042
Granulite
Alteration, high pressure effects: Green, D. H. 06239
Metasediments
Petrology, Precambrian subgraywackes, Utah: Condie, Kent C. 05982
Migmatite
Structural features, South Carolina, Piedmont: Griffin, Villard S., Jr. 06046
Mineral assemblages
California, Ben Lomond Mtn. area: Leo, Gerhard W. 06294
California, Santa Cruz area, Kalkar limestone quarry: Gross, Eugene B. 06388
Connecticut, Old Lyme quadrangle, Paleozoic units: Lundgren, Lawrence, Jr. 06000
Connecticut, Waterbury quadrangle, Waterbury and Hartland Formations: Gates, Robert M. 06098
Mineral composition
Clinoamphiboles, crystal structure, exsolution: Ross, Malcolm. 00177
Mineral facies
Nevada, Gold Butte area, Precambrian complex, vermiculitization: Leighton, F. Beach. 06312
Quebec, Belleau–Desaulniers area, Precambrian: Philpotts, A. R. 06099
Orbiculite
Petrology, Washington, Jove Peak: VanDiver, Bradford B. 00275
Quartzite
Alteration, deformation by intergranular flow: Heard, Hugh C. 00274

Metamorphism
Contact
Epigenetic mineral deposits, wallrock alteration, regularities: Boyle, R. W. 06284
Experimental studies
Pyroxene, pressure-temperature relations: Coleman, R. G. 00276
General
Textbook, mineralogical-chemical aspects: Winkler, Helmut G. F. 06402
Grade
Effect on K–Rb ratios in amphiboles, Minnesota: Griffin, W. L. 00316
Migration of elements
Pyroxenes, related to original rocks: Coleman, R. G. 00276

Metamorphism
Regional
Granulite facies mineral assemblages, Minnesota, gneisses: Himmelberg, G. R. 06042
Nova Scotia, Shelburne map area: Taylor, F. C. 06318
Retrograde
Granulite facies mineral assemblages, Minnesota, gneisses: Himmelberg, G. R. 06042
Meteor craters
Earth
Impact theory, asteroidal: Cohenour, Robert E. 00371
Meteorites
Age
Four Corners, Toluca, silicate inclusions: Bogard, D. 00314
Iodine–xenon dating, achondrites: Hohenberg, C. M. 00318
Composition
Chondrites, unequilibrated, noble gases: Heymann, D. 00297
Gold content, neutron activation analysis: Linn, T. A., Jr. 00205
Hydrocarbons, genesis, solar nebula: Studier, Martin H. 00291
Mean atomic weight, cf. planets and Earth: Anderson, Don L. 06411
Nitrogen compounds, genesis, solar nebula: Hayatsu, Ryoichi. 00294
Pyroxene minerals, cf. terrestrial pyroxenes: Mason, Brian. 00331
Cosmic dust
Flux, measurements: Parkin, David W. 00176
General
Review: Mason, Brian. 06267
Holbrook
Composition, organic, analyses: Hayes, J. M. 00295
Isotopes, lithium: Gradsztajn, Eli. 00212
Isotopes
Tritium, loss by solar wind hydrogen: Wagener, K. 06364
Xenon, sources in achondrites: Munk, Miner N. 00206
Murray
Composition, hydrocarbons, genesis: Studier, Martin H. 00291
Composition, organic, analyses: Hayes, J. M. 00295
Organic matter
Abiogenic origin: Mueller, G. 06394
Analyses, mass spectrometric technique: Hayes, J. M. 00295
Orgueil
Composition, hydrocarbons, genesis: Studier, Martin H. 00291
Composition, nitrogen compounds, genesis: Hayatsu, Ryoichi. 00294
Shallowater
Age, iodine–xenon dating: Hohenberg, C. M. 00318
Meteorites
Toluca
Cooling rate, Pu–244 fission tracks: Fleischer, R. L. 00298
Mexico
Earthquakes
Seismicity, Mexico City area, magnitude–frequency relation: Ferraes, Sergio G. 00204
Economic geology
Petroleum, exploration, geophysical, developments, methods: Figueroa, S. 06450
Petroleum, natural gas, exploration, production, 1863–1966: Cervera, Eduardo. 06443
Petroleum, Tampico embayment, occurrence: Guzman, Eduardo J. 06438
Mineralogy
Perlite, Sonora, Alamos area, gem variety: Broughton, Paul L. 00358
Mica
North Carolina
Blue Ridge area, occurrence: Lesure, Frank G. 00261
Michigan
Hydrogeology
Kalamazoo area, artificial recharge, induced interaquifer leakage: Deutsch, Morris. 06124
Microseisms
Interpretation
Mode structure, sources, LASA, Montana: Toksoz, M. Nafi. 00174
Mineral collecting
Maine
Rumford area, Black Mtn. pegmatite quarries: Gregory, Gardiner E. 00365
Mineral data
Analcite
Composition, description, California: Gude, Arthur J., 3d. 06201
Andesine
Structure, superlattice maxima, high-temperature diffraction data: Foit, Franklin F., Jr. 05992
Anorthite
Structure, supperlattice maxima, high-temperature diffraction data: Foit, Franklin F., Jr. 05992
Aragonite
Transformation from vaterite: Bischoff, J. L. 00278
Transformation to calcite: Bischoff, J. L. 00277
Biotite
Iron-rich, properties, weathering: Rimsaite, J. 06191
Calcite
Transformation from aragonite: Bischoff, J. L. 00277
Chrysotile
Surface properties and texture: Fripiat, J. J. 06185
Cinnabar
Synthetic, crystal growth, vapor phase: Carlson, Ernest H. 06270

Mineral data
Clinoamphibole
Structure, exsolution in metamorphic rocks: Ross, Malcolm. 00177
Clinopyroxene
Structure, nomenclature scheme: Burnham, Charles W. 05991
Djurleite
Structure: Takeda, Hiroshi. 05985
Twinning: Takeda, Hiroshi. 06008
Feldspar
Alteration, coexisting orthoclase and microcline, Nevada: Wones, David R. 06027
Heterogeneity, optical and chemical, Canadian rocks: Rimsaite, J. 06026
Plagioclase, structure and composition effect on pericline and albite twinning: Starkey, John. 06028
Triclinic, structure, lattice angles, changes at elevated temperature: Grundy, H. D. 06094
Garnet
Crystal chemistry and structure: Geller, S. 06071
Lanthanide content: Masuda, Akimasa. 06423
Glauconite
Morphology and internal structure: Konta, J. 06426
Morphology and internal structure: Triplehorn, D. M. 06427
Metacinnabar
Synthetic, crystal growth, vapor phase: Carlson, Ernest H. 06270
Micas
K depletion, color changes and increase in thickness: Scott, A. D. 06190
Muscovite
Structure, 3*T* form, cf. $2M_1$, Washington: Guven, Necip. 05993
Orthopyroxene
Metamorphic and volcanic, Mg^{2+}–Fe^{2+} distribution, site occupancy: Ghose, Subrata. 06070
Pectolite
Structure, refinement: Prewitt, C. T. 05995
Pharmacosiderite
Structure and composition: Buerger, M. J. 05984
Phlogopite
Stability at high pressure, upper mantle: Kushiro, I. 06412
Plagioclase
Trace-element concentrations, electron-microprobe analyses: Corlett, M. 06029
Pyroxene
Genesis, blueschist facies, California: Coleman, R. G. 00276
Lanthanide content: Masuda, Akimasa. 06423
Meteoritic, cf. terrestrial: Mason, Brian. 00331
Quartz
Deformation, intergranular, experimental: Heard, Hugh C. 00274

Mineral data
Silica minerals
Solubility, aqueous suspensions, silicic acid formation: Stober, Werner. 06416
Sulfur
Structure, orthorhombic, produced by photosynthetic S bacteria: Truper, Hans G. 06003
Vaterite
Transformation to aragonite: Bischoff, J. L. 00278
Vermiculite
Nevada, Gold Butte area, alteration from biotite: Leighton, F. Beach. 06312
Zeolites
Chabazite–herschelite gradation, Arizona, Bowie area: Regis, A. J. 06203
Zincite
Synthetic, crystal growth, vapor phase: Weaver, E. A. 06234
Zircon
Crystallization in igneous rocks, diverse P-T conditions: Dietrich, R. V. 00330
Mineral deposits, genesis
Copper
New Mexico, Santa Rita area: Nielsen, R. L. 06282
Copper–zinc
Canada, Archean sulfides, remobilization: Suffel, G. G. 06273
Epigenetic processes
Wallrock alteration, regularities: Boyle, R. W. 06284
Fluorite–zinc
Illinois, southern, Hicks Dome: Hall, W. E. 06278
Gold
Nevada, Carlin area, Lynn mining district: Hausen, D. M. 06279
Iron
Canada, eastern, Appalachian and Grenville regions: Gross, G. A. 06296
Lead–zinc
Northwest Territories, Pine Point area: Folinsbee, R. E. 06286
Metamorphism
California, Santa Cruz area, Kalkar limestone quarry: Gross, Eugene B. 06388
Nickel–copper
Ontario, Sudbury district, Strathcona mine: Naldrett, A. J. 06044
Ores in sedimentary rocks
Sphalerite replacement of limestone: Holland, H. D. 06280
Source rocks
Hydrothermal deposits, metals and gangue elements: Boyle, R. W. 06285
Vermiculite
Nevada, Gold Butte area: Leighton, F. Beach. 06312
Zinc
Tennessee, eastern, Ordovician formations: Ridge, J. D. 06283

Mineral economics
Alabama
Resources, industry, production: Szabo, Michael W. 06375
Uranium
Canada, cf. United States and Free World: Griffith, J. W. 06293
Mineral exploration
Geophysical methods
Seismic refraction: Elliot, Charles L. 06288
Seismic refraction, salt: Musgrave, A. W. 06287
Marine methods
Shipboard computer system: Schneidewind, N. F. 06301
Photogeologic methods
Space photos: Fischer, William A. 00352
Well grid
Proposed program, United States: Griffiths, John C. 06454
Mineralogy
Crystal growth
Aragonite, transformed from vaterite, ion effect: Bischoff, J. L. 00278
Calcite, transformed from aragonite: Bischoff, J. L. 00277
Cinnabar, metacinnabar, experimental: Carlson, Ernest H. 06270
Zincite, experimental: Weaver, E. A. 06234
Physical properties
Thermal conductivity, radiative, experimental data: Aronson, J. R. 06366
Practice
Analytical techniques, current trends: Howie, R. A. 06419
Statistical methods
Markov models: Blyth, Colin R. 06372
Mining geology
History
Nickel, sulfide and lateritic deposits, world wide: Boldt, Joseph R., Jr. 06321
Technology
Nickel, sulfide and lateritic deposits, world wide: Boldt, Joseph R., Jr. 06321
Minnesota
Absolute age
Granite Falls area, mafic dikes: Hanson, G. N. 06018
Geochemistry
Granite Falls–Montevideo area, gneisses, mineral equilibria: Himmelberg, G. R. 06042
Vermillion Range, Ely Greenstone, K–Rb ratios in amphiboles: Griffin, W. L. 00316
Petrology
Granite Falls–Montevideo area, Precambrian gneisses, metamorphism: Himmelberg, G. R. 06042
Mississippi
Engineering geology
Channel control, Vicksburg area, river, stage effects: Franco, John J. 06170
River control, Vicksburg District: Anding, Malcolm G. 06163
Mississippi
Geomorphology
Vicksburg area, river bank erosion, stage effects: Franco, John J. 06170
Mississippian
Alberta
Southwestern, stratigraphy, Lower and Middle series: Macqueen, R. W. 06102
Arkansas
Northern, stratigraphy: Ogren, David E. 00306
Pennsylvania
South–central and western, Mauch Chunk Formation: Hoque, Momin ul. 00311
Missouri
Stratigraphy
Cambrian–Permian, Forest City basin: Anderson, K. H. 00265
Structural geology
Forest City basin, history: Anderson, K. H. 00265
Mollusca
Tracks
Orientation, river point–bars, clue to paleogeography: Pryor, Wayne A. 06325
Monazite
United States
Southeastern, placers, possibilities: Overstreet, William C. 00323
Montana
Earthquakes
Microseisms, mode structure, sources: Toksoz, M. Nafi. 00174
Economic geology
Petroleum, Bell Creek field, discovery: Gary, Samuel. 00168
Maps, geologic
Castle Reef quadrangle: Mudge, Melville R. 00336
Paleontology
Palynomorphs, Cretaceous, Fox Hills Sandstone: Hall, John W. 06062
Petrology
Stillwater intrusion, layering, crystal fractionation: Wager, L. R. 00366
Stratigraphy
Cambrian–Cretaceous, Castle Reef quadrangle, sections: Mudge, Melville R. 00336
Pennsylvanian–Permian, paleogeography: Maughan, Edwin K. 05989
Moon
Genesis
Non–catastrophic, Cambrian age, fossil evidence: Lamar, D. L. 06006
Nebraska
Stratigraphy
Miocene, Gering Formation, Wildcat Ridge: Schultz, C. Bertrand. 06033
Oligocene, Brule Formation, Wildcat Ridge: Schultz, C. Bertrand. 06033

Neon
Geochemistry
Chondritic meteorites, unequilibrated, analyses: Heymann, D. 00297
Nevada
Absolute age
Ruby Mountains, granitic rocks, Oligocene age: Willden, Ronald. 05981
Economic geology
Gold, Carlin area, Lynn mining district, occurrence: Hausen, D. M. 06279
Gold, Cortez area, Roberts Mts. thrust plate, occurrence: Wells, J. D. 06274
Gold, north central, occurrence: Roberts, R. J. 06397
Vermiculite, Gold Butte area, occurrence: Leighton, F. Beach. 06312
Engineering geology
Rock mechanics, Nevada Test Site, granodiorite, failure: Giardini, A. A. 00287
Geophysical surveys
Dixie Valley, structures: Smith, Thomas E. 00288
Maps, geologic
Gold Butte vermiculite deposits, Clark County: Leighton, F. Beach. 06312
Mineralogy
Orthoclase and microcline, coexisting, West Humboldt Range: Wones, David R. 06027
Zeolites, north central, layered deposits: Studer, H. P. 06200
Petrology
West Humboldt Range, volcanic rocks, alteration: Wones, David R. 06027
Stratigraphy
Precambrian, Great Basin: Condie, Kent C. 06355
Structural geology
Dixie Valley, basement, aeromagnetic data: Smith, Thomas E. 00288
North-central, orogenic belts, relation to gold deposits: Roberts, R. J. 06397
Ruby Mountains, thrust faulting, age: Willden, Ronald. 05981
New Hampshire
Hydrogeology
Merrimack River valley, lower, ground water resources: Weigle, James M. 00322
Maps, ground water
Merrimack River valley, lower: Weigle, James M. 00322
Marine geology
Possibilities for development: Beck, Frederick M. 06298
New Jersey
Hydrogeology
Princeton area, artificial recharge, Millstone River, bank storage: DeWiest, Roger J. M. 06137
Mineralogy
Pectolite, Bergen Hill area, structure, refinement: Prewitt, C. T. 05995
Petrology
Triassic basin, fault border conglomerates, provenance: Park, Yong Ahn. 06150
New Mexico
Absolute age
Rio Grande gorge, basalts, reliability: Ozima, M. 00272
Economic geology
Copper, Santa Rita quartz monzonite stock, occurrence: Nielsen, R. L. 06282
Geomorphology
Dona Ana County, erosional and depositional surfaces: Ruhe, Robert V. 06385
Geophysical surveys
Albuquerque to Golden, Colo., seismic, crustal structure: Sherburne, Roger W. 06073
Hydrogeology
Arkansas River basin, aquifers, ground-water resources, analyses: Ballance, W. C. 06405
Central, bolson alluvium and bedrock aquifers: Titus, Frank B., Jr. 06441
Pecos River basin, ground water resources: Mourant, Walter A. 06440
Rio Grande basin, aquifers, ground water resources: Dinwiddie, George A. 06406
San Juan River basin, ground water resources: Cooper, James B. 06432
Southern High Plains, ground water resources: Ballance, W. C. 06439
Southwestern, closed basins, ground water resources: Doty, Gene C. 06428
Water resources, occurrence, development, uses: New Mexico State Engineer Office. 06442
Western, Lower Colorado River sub-basins, ground water resources: Trauger, Frederick D. 06407
Maps, geologic
Chama quadrangle: Muehlberger, William R. 06384
Las Cruces area: Ruhe, Robert V. 06385
Maps, geomorphologic
Las Cruces area: Ruhe, Robert V. 06385
Maps, structure
Chama quadrangle: Muehlberger, William R. 06384
Paleomagnetism
Tertiary, basalts, Rio Grande gorge: Dalrymple, G. Brent. 00290
Tertiary, basalts, Rio Grande gorge: Ozima, M. 00272
Petrology
Santa Rita stock, quartz monzonite porphyry, zoning: Nielsen, R. L. 06282
Sedimentary petrology
Dona Ana County, surficial deposits: Ruhe, Robert V. 06385
Stratigraphy
Arkansas River basin: Ballance, W. C. 06405
Central, closed basins: Titus, Frank B., Jr. 06441
Devonian system: Baars, D. L. 00181
Lower Colorado River sub-basins: Trauger, Frederick D. 06407
Pecos River basin: Mourant, Walter A. 06440

New Mexico
Stratigraphy
Precambrian, Triassic–Tertiary, Chama quadrangle: Muehlberger, William R. 06384
Rio Grande basin: Dinwiddie, George A. 06406
San Juan River basin: Cooper, James B. 06432
Southern High Plains: Ballance, W. C. 06439
Southwestern, closed basins: Doty, Gene C. 06428
Structural geology
Chama quadrangle, faults, folds: Muehlberger, William R. 06384
Dona Ana County: Ruhe, Robert V. 06385
New York
Absolute age
Balmat area, lead, concordia plots: Russell, R. D. 00372
Engineering geology
Waste disposal, Long Island, injection wells, salt-water barrier: Cohen, Philip. 06129
Hydrogeology
Long Island, salt water intrusion, injection well barrier: Cohen, Philip. 06129
Paleontology
Conodonts, Devonian, Rhinestreet Shale, redescription: Huddle, John W. 00209
Newfoundland
Maps, aeromagnetic
Badger area: Canada Geological Survey. 00214
Buchans area: Canada Geological Survey. 00215
Burnt Hill area: Canada Geological Survey. 00228
Burnt Pond area: Canada Geological Survey. 00235
Cold Spring Pond area: Canada Geological Survey. 00238
Corner Brook area: Canada Geological Survey. 00248
Dashwoods Pond area: Canada Geological Survey. 00236
Dead Wolf Pond area: Canada Geological Survey. 00220
Flat Bay area: Canada Geological Survey. 00255
Gambo area: Canada Geological Survey. 00224
Gander area: Canada Geological Survey. 00217
Gander Lake area: Canada Geological Survey. 00256
Glovertown area: Canada Geological Survey. 00230
Grand Falls area: Canada Geological Survey. 00218
Great Burnt Lake area: Canada Geological Survey. 00229
Great Gull Lake area: Canada Geological Survey. 00225
Harry's River area: Canada Geological Survey. 00245
Newfoundland
Maps, aeromagnetic
Howley Lake area: Canada Geological Survey. 00241
Kepenkeck Lake area: Canada Geological Survey. 00226
King George IV Lake area: Canada Geological Survey. 00237
Lake Ambroise area: Canada Geological Survey. 00222
Little Friars Cove area: Canada Geological Survey. 00254
Little Grand Lake area: Canada Geological Survey. 00247
Main Gut area: Canada Geological Survey. 00243
Mainland area: Canada Geological Survey. 00250
Meta Pond area: Canada Geological Survey. 00233
Miguels Lake area: Canada Geological Survey. 00221
Mount Peyton area: Canada Geological Survey. 00216
Mount Sylvester area: Canada Geological Survey. 00232
Noel Paul's Brook area: Canada Geological Survey. 00223
Port Blandford area: Canada Geological Survey. 00240
Puddle Pond area: Canada Geological Survey. 00242
Pudops Lake area: Canada Geological Survey. 00231
Rainy Lake area: Canada Geological Survey. 00249
Red Indian Lake area: Canada Geological Survey. 00257
Saint Fintans area: Canada Geological Survey. 00253
Serpentine area: Canada Geological Survey. 00251
Shag Island area: Canada Geological Survey. 00252
Snowshoe Pond area: Canada Geological Survey. 00227
Star Lake area: Canada Geological Survey. 00246
Stephenville area: Canada Geological Survey. 00244
Stephenville area: Canada Geological Survey. 00258
Tug Pond area: Canada Geological Survey. 00239
Twillick Brook area: Canada Geological Survey. 00234
West Gander Rivers area: Canada Geological Survey. 00219
Nicaragua
Petrology
Northwestern, Miocene ignimbrites, fiamme: McBirney, Alexander R. 00353

Nickel
Canada
Occurrence, exploration, mining methods: Boldt, Joseph R., Jr. 06321
Caribbean region
Occurrence, exploration, mining methods: Boldt, Joseph R., Jr. 06321
General
Occurrence, exploration, mining methods: Boldt, Joseph R., Jr. 06321
Geochemistry
Oil shale, Fe-Ni ratio: Houghton, A. Sherrill. 06260
Ontario
Sudbury district, Strathcona mine, genesis: Naldrett, A. J. 06044
United States
Occurrence, exploration, mining methods: Boldt, Joseph R., Jr. 06321
Nitrogen
Geochemistry
Ground water contamination: Keller, W. D. 06218
Meteorites, genesis of compounds: Hayatsu, Ryoichi. 00294
Nodules
Sulfide
Gold content: Linn, T. A., Jr. 00205
North America
Areal geology
Great Plains, relation to prehistoric man and mammals: Reider, Richard G. 00259
Northeastern, cf. northwestern Europe, similarities, age: Rioult, Michel. 06361
Economic geology
Gold, reserves: Kavanagh, Paul M. 05998
Oil shale, exploration, field reconnaissance methods: Ertl, Tell. 06263
General
Current research, paleontological, specialties 1967: Westermann, G. E. G. 00339
Paleoclimatology
Quaternary, Great Plains, inorganic organic association: Reider, Richard G. 00259
Paleontology
Man, fossil, Quaternary, Great Plains: Reider, Richard G. 00259
Paleozoic-Cenozoic, eastern, correlation with Europe, drift evidence: Rioult, Michel. 06361
Palynomorphs, Cretaceous, Upper, *Ariadnaesporites*: Hills, L. V. 06063
Pelecypoda, Cenozoic, *Morum*, fossil and Recent: Dance, S. Peter. 06035
Petrology
Layered intrusions, various types, crystal fractionation: Wager, L. R. 00366
Stratigraphy
Cambrian, lower boundary, biostratigraphy: Rozanov, A. Yu. 06051
Paleozoic-Cenozoic, eastern, correlation with Europe, drift evidence: Rioult, Michel. 06361
North Carolina
Areal geology
Great Smoky Mountains National Park: King, Philip B. 00263
Economic geology
Pegmatite, Blue Ridge area: Lesure, Frank G. 00261
Maps, geologic
Blue Ridge area: Lesure, Frank G. 00261
Great Smoky Mountains National Park: King, Philip B. 00263
Maps, mineral resources
Blue Ridge area, mica districts: Lesure, Frank G. 00261
Heavy minerals: Overstreet, William C. 00323
Paleontology
Ostracoda, Miocene-Pliocene, Waccamaw Formation: Swain, Frederick M. 00262
Sedimentary petrology
Coastal plain, Black Creek Formation, tidal deposit: Swift, Donald J. P. 06324
Stratigraphy
Cretaceous, Upper, coastal plain: Swift, Donald J. P. 06324
North Dakota
Areal geology
Eddy and Foster Counties, popular account: Bluemle, John P. 06383
Economic geology
Petroleum, Williston basin, exploration, diagenetic principles: Miller, D. N., Jr. 06015
Maps, geologic
Eddy and Foster Counties: Bluemle, John P. 06383
Paleontology
Insecta, Paleocene, upper, Dickinson area: Fennah, R. G. 00325
Sedimentary petrology
Williston basin, sediments, porosity and permeability: Miller, D. N., Jr. 06015
Stratigraphy
Pennsylvanian-Permian, paleogeography: Maughan, Edwin K. 05989
Northwest Territories
Absolute age
Ellesmere Island, shells, post-glacial uplift rate: Hattersley-Smith, G. 06053
Keewatin, northeastern, and Melville Peninsula: Heywood, W. W. 06045
Areal geology
Keewatin, northeastern: Heywood, W. W. 06045
Melville Peninsula, southern: Heywood, W. W. 06045
Economic geology
Lead-zinc, Pine Point area, genesis: Folinsbee, R. E. 06286
Oil sands, Melville Island, occurrence: Trettin, H. P. 06244
Uranium, Great Bear Lake and Marian River area, production, history: Griffith, J. W. 06293

Northwest Territories
Geophysical surveys
Ellef Ringnes Island–Belcher Channel, seismic, crustal studies: Hobson, George D. 06395
Maps, aeromagnetic
Franklin, Sheet 99 A/SE, part of 89 B/SW, Polar Continental Shelf: Canada Geological Survey. 06338
Franklin, Sheet 109 C/NE, Polar Continental Shelf: Canada Geological Survey. 06340
Franklin, Sheet 109 C/NW, Polar Continental Shelf: Canada Geological Survey. 06341
Franklin, Sheet 109 E/ NE, Polar Continental Shelf: Canada Geological Survey. 06344
Franklin, Sheet 109 E/ SE, Polar Continental Shelf: Canada Geological Survey. 06343
Franklin, Sheet 109 F/ NE, Polar Continental Shelf: Canada Geological Survey. 06345
Franklin, Sheet 109 G/NE, Polar Continental Shelf: Canada Geological Survey. 06353
Franklin, Sheet 109 G/ NW, Polar Continental Shelf: Canada Geological Survey. 06354
Franklin, Sheet 109 G/SE, Polar Continental Shelf: Canada Geological Survey. 06348
Franklin, Sheet 109 G/SW, Polar Continental Shelf: Canada Geological Survey. 06349
Franklin, Sheet 109 H/NE, part of 1000 B/SE, Polar Continental Shelf: Canada Geological Survey. 06351
Franklin, Sheet 109 H/NW, Polar Continental Shelf: Canada Geological Survey. 06352
Franklin, Sheet 109 H/SE, Polar Continental Shelf: Canada Geological Survey. 06347
Franklin, Sheets 89 C/NW, 89 C/NE, Polar Continental Shelf: Canada Geological Survey. 06339
Franklin, Sheets 99 E/SE, 89 C/NE, Polar Continental Shelf: Canada Geological Survey. 06342
Franklin, Sheets 99 G/NW, 99 G/NE, Polar Continental Shelf: Canada Geological Survey. 06350
Franklin, Sheets 99 G/SE, 99 H/SW, Polar Continental Shelf: Canada Geological Survey. 06346
Maps, geologic
Keewatin, northeastern: Heywood, W. W. 06045
Melville Peninsula, north of Lyon Inlet: Heywood, W. W. 06045
Melville Peninsula, southern: Heywood, W. W. 06045
Paleontology
Brachiopoda, Triassic, Ellesmere and Table Islands, spiriferinid: Logan, A. 06149
Pisces, Devonian, Lower, Ross River region, new dipnoan: Jarvik, Erik. 06379
Trilobita, Cambrian, Ellesmere Island, assemblages: Kerr, J. William. 06306
Stratigraphy
Precambrian–Cambrian, Ellesmere Island, eastern, central: Kerr, J. William. 06306

Northwest Territories
Structural geology
Ellesmere Island, geosynclines, unconformities: Kerr, J. William. 06306
Tanquary Fiord, glacial rebound: Hattersley-Smith, G. 06053
Nova Scotia
Geomorphology
Sable Island, sand transport, sea, wind: James, Noel P. 06058
Glacial geology
Minas Basin, fluviomarine outwash: Swift, Donald J. P. 06367
Maps, geologic
Shelburne area: Taylor, F. C. 06313
Shelburne map area: Taylor, F. C. 06318
Marine geology
Gully submarine canyon, sediments: Stanley, Daniel J. 00320
Paleontology
Pisces, Devonian, Knoydart Formation: Dineley, D. L. 06386
Petrology
Shelburne map area, granitic plutons and basic intrusives: Taylor, F. C. 06318
Stratigraphy
Devonian, Knoydart Formation, biostratigraphy: Dineley, D. L. 06386
Ordovician–Silurian, Meguma and White Rock formations, Shelburne map area: Taylor, F. C. 06318
Oceanography
Practice
Maine, New Hampshire, development possibilities: Beck, Frederick M. 06298
Popular account: Bixby, William. 06444
Resource development, implications at state, local levels: Antman, Herbert S. 06297
Resource development, local jurisdictions, role: Kvammen, Kenneth R. 06299
Ohio
Engineering geology
Dams, Licking River basin, Utica site: U.S. Army Corps Engineers. 06276
Geomorphology
Western, Whitewater River, point-bars, biogenic directional features: Pryor, Wayne A. 06325
Glacial geology
Utica area, buried gorge, outwash mantle: U.S. Army Corps Engineers. 06276
Oil and gas fields
Mexico
Golden Lane, Poza Rica trends, reef type traps: Guzman, Eduardo J. 06438
Montana
Bell Creek oil field: Gary, Samuel. 00168
North Dakota
Williston Basin, stratigraphic traps in nonreef carbonate: Illing, L. V. 06399
Saskatchewan
Williston Basin, stratigraphic traps in nonreef carbonate: Illing, L. V. 06399

Oil sands
Alberta
Athabasca tar sand, properties: Carrigy, M. A. 06255
Northwest Territories
Melville Island, occurrence: Trettin, H. P. 06244
World
Occurrence, major deposits: Phizackerley, P. H. 06254
Oil shale
Alaska
Northern, geochemistry, oil yield: Tourtelot, Harry A. 06261
Colorado
Occurrence, production, Green River Formation: Donnell, John R. 06259
Piceance Basin, yield prediction from well logs: Tixier, M. P. 06262
Uinta Basin, geochemistry, organic, Fe Ni ratio: Houghton, A. Sherrill. 06260
Exploration
Field reconnaissance methods: Ertl, Tell. 06263
Genesis
Modern lake analogs, organic ooze: Bradley, W. H. 06258
Geochemistry
Kerogens, bitumen: Robinson, W. E. 06257
Utah
Occurrence, production, Green River Formation: Donnell, John R. 06259
Uinta Basin, geochemistry, organic, Fe Ni ratio: Houghton, A. Sherrill. 06260
World
Occurrence, distribution: Duncan, D. C. 06256
Wyoming
Occurrence, production, Green River Formation: Donnell, John R. 06259
Oklahoma
Mineralogy
Analcite, Wichita Mountains, Tepee Creek Formation, diagenesis: Bellis, William H. 06202
Paleontology
Palynomorphs, Cretaceous, Red Branch Member, spores, revision: Hedlund, Richard W. 06061
Trilobita, Silurian, Henryhouse Formation: Campbell, K. S. W. 06139
Sedimentary petrology
Chester oolite, porosity, relict primary: Lucia, F. Jerry. 06437
Moorefield Formation, Lindsey Bridge Member, crossbedding: Swinchatt, Jonathan P. 06409
Northern, Senora Formation, Excello Shale Member: Cassidy, Martin M. 00307
Wichita Mountains, Tepee Creek Formation, zeolitized arkose: Bellis, William H. 06202
Stratigraphy
Pennsylvanian, Altamont Limestone, cyclothem: Schenk, Paul E. 06005
Oklahoma
Stratigraphy
Pennsylvanian, Senora Formation, Excello Shale Member, northern: Cassidy, Martin M. 00307
Ontario
Areal geology
Bay of Islands area: Card, K. D. 06054
Bernhardt Township: Rupert, R. J. 00191
Blackstock Township: Pyke, D. R. 00190
Errington–Ashmore Townships, MacLeod Mosher gold mines: Ferguson, S. A. 06087
Langmuir Township: Pyke, D. R. 00189
McGregor Bay area: Card, K. D. 06092
Morrisette Township: Rupert, R. J. 00192
Operation Kapuskasing area: George, P. T. 06093
Trout Lakes area, Rathouse Bay map-area: Ayres, L. D. 00188
Economic geology
Nickel, Sudbury district, exploration, mining methods: Boldt, Joseph R., Jr. 06321
Nickel–copper, Sudbury district, Strathcona mine, genesis: Naldrett, A. J. 06044
Uranium, Elliott Lake district and Bancroft area, production, history: Griffith, J. W. 06293
Geophysical surveys
Operation Kapuskasing area, magnetic, airborne: George, P. T. 06093
Maps, aeromagnetic
Carbonatite–alkalic complexes: Satterly, J. 00347
Operation Kapuskasing area: George, P. T. 06093
Maps, geologic
Bay of Islands sheets: Card, K. D. 06054
Bernhardt Township: Rupert, R. J. 00191
Blackbear River sheet: Bennett, G. 06084
Blackstock Township: Pyke, D. R. 00190
Cartier sheet: Card, K. D. 06090
Errington–Ashmore Townships, MacLeod Mosher gold mines, surficial: Ferguson, S. A. 06087
Langmuir Township: Pyke, D. R. 00189
McGregor Bay sheets: Card, K. D. 06092
Morrisette Township: Rupert, R. J. 00192
Operation Kapuskasing area: George, P. T. 06093
Rathouse Bay sheet, Trout Lakes area: Ayres, L. D. 00188
Stull Lake sheet: Riley, R. A. 06082
Sudbury mining area: Card, K. D. 00186
Swan Lake sheet: Bennett, G. 06083
Trout Lakes area, South Trout Lake sheet: Ayres, L. D. 00187
Varveclay Lake sheet: Bennett, G. 06086
Westree sheet: Card, K. D. 06091
Witegoo River sheet: Bennett, G. 06085
Mineralogy
Biotite, Blue Mountain nepheline deposit, weathering: Rimsaite, J. 06191
Petrology
Sudbury district, Strathcona mine, noritic intrusions: Naldrett, A. J. 06044

Ontario
Sedimentary petrology
Huronian rocks, sedimentary structures: Young, Grant M. 00361
Stratigraphy
Precambrian, MacLeod Mosher gold mines, cross sections: Ferguson, S. A. 06089
Precambrian, MacLeod Mosher gold mines, longitudinal projection: Ferguson, S. A. 06088
Ordovician
Nova Scotia
Shelburne map area, Meguma and White Rock formations: Taylor, F. C. 06318
Yukon
Graptolithina, Tremadocian: Jackson, D. E. 06050
Oregon
Geomorphology
Columbia River, sediment transport, bed forms: Whetten, John T. 06310
Mineralogy
Zeolites, southeastern, layered deposits: Studer, H. P. 06200
Organic materials
Analytical data
Meteorites, Murray and Holbrook: Hayes, J. M. 00295
Analytical methods
Mass spectrometry, high resolution: Hayes, J. M. 00295
Bitumens
Composition in oil shale: Robinson, W. E. 06257
General
Meteorites, abiogenic origin: Mueller, G. 06394
Genesis
First appearance: Calvin, Melvin. 06069
Humates
Soils, interaction with montmorillonite: Kodama, H. 06195
Hydrocarbons
Meteorites, genesis: Studier, Martin H. 00291
Kerogen
Composition, role in petroleum genesis: McIver, Richard D. 06435
Oil shale, Colorado–Utah, Fe–Ni ratio: Houghton, A. Sherrill. 06260
Structure in oil shale: Robinson, W. E. 06257
Orogeny
Acadian
Quebec, Chandler–Port-Daniel area: Ayrton, W. G. 06326
Taconic
Quebec, Chandler–Port-Daniel area: Ayrton, W. G. 06326
Ostracoda
Tertiary
North Carolina, South Carolina, Waccamaw Formation, Miocene–Pliocene: Swain, Frederick M. 00262
Oxygen
Isotopes
O-18, O-16, fractionation, calcareous marine invertebrates: Weber, Jon N. 00299
O-18/O-16, Greenland Icecap, core: Hamilton, W. L. 00321
Pacific Ocean
Geochemistry
Central America, coastal, C-14, marine shells: Taylor, R. E. 06233
Radium-226, radon-222 distribution: Broecker, Wallace S. 06232
Paleobotany
Environmental analysis
Seed viability, records and experiments: Black, Michael. 06127
Paleoclimatology
Cenozoic
North America, Great Plains, inorganic–organic association: Reider, Richard G. 00259
Cretaceous–Tertiary
California, Escarpedo Canyon area: Drugg, W. S. 06100
Indicators
Palynology: Bryant, Vaughn M., Jr. 00260
Precambrian
Utah, northern: Condie, Kent C. 05982
Quaternary
Barbados, Milankovitch hypothesis supported by absolute dating: Broecker, Wallace S. 00211
Temperature
Isotope studies, C-13 and O-18 in shells: Mook, W. G. 00173
Paleoecology
Pelecypoda
Miocene, pholad burrows, California, Monterey Formation: Evans, John W. 06036
Pennsylvanian
Marine, United States, Western Interior basin, Altamont megacyclothem: Schenk, Paul E. 06005
Paleogeography
Carboniferous
Canada–British Isles, rift-valley basins, correlation: Belt, Edward S. 06368
Caribbean region, paleotectonic reconstruction: Rod, Emile. 06266
Caribbean region
Jurassic–Recent: Weyl, R. 06022
Central America
Cretaceous–Tertiary, southern: Henningsen, D. 06095
Paleozoic–Recent: Weyl, R. 06022
Mapping, methods
Point-bar orientation, meander migration direction, biogenic features: Pryor, Wayne A. 06325
Stratigraphic map diagrams, regional: Melton, Frank A. 00308
Montana
Pennsylvanian–Permian: Maughan, Edwin K. 05989

Paleogeography
North Dakota
Pennsylvanian–Permian: Maughan, Edwin K. 05989
Pennsylvanian
United States, Western Interior basin, eastern flank: Schenk, Paul E. 06005
South Dakota
Pennsylvanian–Permian: Maughan, Edwin K. 05989
Triassic
New Jersey, Trenton area: Park, Yong Ahn. 06150
Paleomagnetism
General
Field intensity, Precambrian to present: Carmichael, C. M. 00319
Popular description: Elsasser, Walter M. 06066
Precambrian
Colorado–Wyoming, Front Range, reversals: Eggler, D. H. 00369
Reversals
Deep-sea sediments, cf. dated lavas: Opdyke, N. D. 05983
Tertiary, New Mexico, 3.6–3.7 m.y.: Dalrymple, G. Brent. 00290
Tertiary, New Mexico, 3.6–3.7 m.y.: Ozima, M. 00272
Paleontology
Bibliography
Vertebrata, and related subjects: Blake, Martha A. 06020
Life, origin
Inorganic background: Calvin, Melvin. 06069
Modern approach: Haldane, J. B. S. 06291
Modern approach: Oparin, A. I. 06290
Physical basis: Bernal, J. D. 06393
Practice
North America, paleontologists 1967, distribution, specialties: Westermann, G. E. G. 00339
Paleozoic
Connecticut
Old Lyme quadrangle, metamorphic units, granitic intrusions: Lundgren, Lawrence, Jr. 06000
Iowa
Forest City basin, history: Anderson, K. H. 00265
Kansas
Forest City basin, history: Anderson, K. H. 00265
Missouri
Forest City basin, history: Anderson, K. H. 00265
Quebec
Chandler–Port-Daniel area, stratigraphy: Ayrton, W. G. 06326
United States
Invertebrata, evolution of marine communities, rate: Bretsky, Peter W. 00178
Yukon
Glenlyon map area, stratigraphy: Campbell, R. B. 06319
Palynology
Cretaceous
Alberta, Colorado Group, central, assemblages: Norris, G. 06034
California, Moreno Formation, Fresno County: Drugg, W. S. 06100
Environmental analysis
Lakes, sediment contamination, fossil record disturbance: Nichols, Harvey. 06060
Role in prehistory: Bryant, Vaughn M., Jr. 00260
Methods
Sampling and analysis: Bryant, Vaughn M., Jr. 00260
Tertiary
California, Moreno Formation, Fresno County: Drugg, W. S. 06100
Palynomorphs
Ariadnaesporites
Cretaceous, Upper, taxonomy, morphology, distribution: Hills, L. V. 06063
Ariadnaesporites fluviatilis, n.sp.
Cretaceous, Montana, Fox Hills Sandstone: Hall, John W. 06062
Ariadnaesporites intermedius, n.sp.
Cretaceous, Maryland, Magothy Formation: Hall, John W. 06062
Morphology
Ariadnaesporites, body diameters of species, microspores: Hall, John W. 06062
Nomenclature
Ariadnaesporites, *Capulisporites*, *Caudaspora*: Hills, L. V. 06063
Quadripollis, n.gen.
Cretaceous–Paleocene, California, Moreno Formation: Drugg, W. S. 06100
Taxonomy
Cretaceous, Oklahoma, Red Branch Member, revision: Hedlund, Richard W. 06061
Panama
Geomorphology
Azuera Peninsula, Chitre area, Rio La Villa, photointerpretation: Tricart, J. 06077
Azuera Peninsula, Rio Parita delta area, photointerpretation: Tricart, J. 06076
Baru Volcano, Rio Escarrea area, hydrovolcanic features, photointerpretation: Tricart, J. 06078
Paragenesis
Gneiss
Minnesota, Granite Falls–Montevideo area: Himmelberg, G. R. 06042
Pegmatite
North Carolina
Blue Ridge area, occurrence: Lesure, Frank G. 00261
Pelecypoda
Cretaceous
Growth increments, evidence of longer month and year: Berry, William B. N. 00354
Morum
Cenozoic, fossil and Recent, nomenclature: Dance, S. Peter. 06035

Pelecypoda
Pholadidae
Miocene, California, Monterey Formation, burrows: Evans, John W. 06036

Pennsylvania
Maps, soils
General: Higbee, Howard William. 06249
Sedimentary petrology
South-central, Mauch Chunk Formation, sandstones: Hoque, Momin ul. 00311
Stratigraphy
Mississippian, Mauch Chunk Formation, south-central: Hoque, Momin ul. 00311

Pennsylvanian
Alaska
Upper Chistochina River area, Chisna Formation: Rose, Arthur W. 06314
Colorado
Denver Basin, cyclothems: Momper, James A. 05988
Illinois
Berryville area, pteridophytes: Eggert, Donald A. 06101
Kansas
Brown County, stratigraphy: Bayne, Charles K. 05980
South-central, Kanwaka Shale, Elgin sandstone, stratigraphy: Brown, Sally Liggett. 06001
Oklahoma
Northern, Senora Formation, Excello Shale Member: Cassidy, Martin M. 00307
Rocky Mountains
Sedimentation, symposium: Wyoming Geological Association. 06013
United States
Four Corners area, regional facies relations: Peterson, James A. 05987
Montana, North and South Dakota, stratigraphy: Maughan, Edwin K. 05989
Western Interior basin, Desmoinesian Series, Altamont megacyclothem: Schenk, Paul E. 06005

Permafrost
Experimental studies
Frozen clay suspensions, pressure melting, conductance: Hoekstra, P. 06193
General
Environmental effects: Prince, Paul A. 06038

Permeability
Sandstone
Nonuniformities, reservoir performance: Polasek, Theo L. 06436
Sediments
California, central, subsiding areas: Johnson, A. I. 00312
Soils
Loess: Rosen, Milton J. 00342

Permian
Alaska
Upper Chistochina River area, Mankomen Formation: Rose, Arthur W. 06314

Permian
Colorado
Denver Basin, cyclothems: Momper, James A. 05988
Kansas
Brown County, stratigraphy: Bayne, Charles K. 05980
Rocky Mountains
Sedimentation, symposium: Wyoming Geological Association. 06013
United States
Four Corners area, regional facies relations: Peterson, James A. 05987
Montana, North and South Dakota, stratigraphy: Maughan, Edwin K. 05989

Petrofabrics
Experimental studies
Sediments, magnetic and hydrodynamic controls: Hamilton, N. 06371

Petroleum
Alaska
Cook Island Inlet basin: Osment, F. C. 06404
Canada
Northwestern, exploration, Devonian reefs: Hriskevich, M. E. 06236
Exploration
Application of diagenetic principles: Miller, D. N., Jr. 06015
Geophysical, developments and methods, Mexico: Figueroa, S. 06450
Gulf of Mexico, history: Blattner, S. D. 06451
Hydrodynamic analysis, application: Hubbert, M. King. 06403
Magnetic methods, dual-level airborne: Jenny, W. P. 00363
Migration, entrapment, marine sediments, computer simulation: Harbaugh, John W. 06447
Offshore, seismic, streamer receivers, depth control: Davis, B. W. 06304
Seismic methods, reflection, interpretation, linear filter model: McDonal, F. J. 06453
Seismic methods, reflection, interpretation, stratigraphic traps: Boulware, Robert A. 06398
Seismic methods, surface energy sources: Johnson, James F. 06448
Stratigraphic traps, predictive geological models: Moore, Peter Gerald. 06455
Well grid, proposed, United States: Griffiths, John C. 06454
Genesis
Geologic controls: Hedberg, H. D. 06433
Hydrocarbons of low molecular weight, geochemical origin: Erdman, J. Gordon. 06434
Kerogen, composition: McIver, Richard D. 06435
Geochemistry
Hydrocarbons, low molecular weight, genesis: Erdman, J. Gordon. 06434
Kentucky
Quality quadrangle, occurrence: Gildersleeve, Benjamin. 00334

Petroleum
Kentucky
Redbush quadrangle, occurrence: Rice, Charles L. 00335
Mexico
Exploration, production, 1863–1966: Cervera, Eduardo. 06443
Tampico embayment, occurrence, reef-type traps: Guzman, Eduardo J. 06438
Montana
Bell Creek field, discovery: Gary, Samuel. 00168
Possibilities
Pre-Silurian reservoir rocks: Becker, Leroy E. 00310
Prince Edward Island
Possibilities: Williams, E. P. 06365
Reserves
World, ultimate and proved: Ion, D. C. 06445
Reservoirs
Carbonate, nonreef, Williston Basin, stratigraphic traps: Illing, L. V. 06399
Exploration, seismic reflection, interpretation: Boulware, Robert A. 06398
Exploration, seismic reflection, interpretation: McDonal, F. J. 06453
Exploration, stratigraphic traps, predictive model: Moore, Peter Gerald. 06455
Rocky Mountains
Exploration, application of sedimentation, data, symposium: Wyoming Geological Association. 06013
Utah
Uinta basin and central-southeastern, impregnated sandstone: Ritzma, Howard R. 06064

Phase equilibria
Andesite
Experimental studies, hydrous conditions: Green, Trevor H. 00166
Arsenolite–claudetite
Transition temperature: White, William B. 06010
Basalt
Experimental studies, hydrous conditions: Green, Trevor H. 00166
Basaltic magma
Experimental studies: Yagi, Kenzo. 06243
Water and oxygen pressure influence: Hamilton, D. L. 06231
Ca–Al–Si–H–O
Four phase curve, 1 to 10 kilobars: Stewart, David B. 06025
Granite magma
Experimental study, zirconium behavior: Dietrich, R. V. 00330
HgS–HCl
Metacinnabar and cinnabar: Carlson, Ernest H. 06270
K–Al–Mg–Si–O–H
Relations from 700° 1200°C, 3 kb: Luth, W. C. 06043
Natural waters
Relation of biological activity: Lee, G. Fred. 06413

Phase equilibria
Olivine–spinel solid solution
Transition in mantle: Akimoto, Syun-iti. 00281
Ore-forming fluid
Sphalerite replacement of limestone: Holland, H. D. 06280
Potassic magmas
Melting relations, experimental studies: Luth, W. C. 06043
Sea water
Heterogeneous equilibria, of major and minor constituents: Schindler, Paul W. 06417
Senarmontite–valentinite
Transition temperature: White, William B. 06010
Silicate systems
Granitic glass and aqueous phase, melt compositions: Gammon, J. B. 06396
SiO_2
Experimental studies, silicic acid formation in aqueous suspensions: Stober, Werner. 06416
$ZnCl_2$–H_2O
Zincite, vapor phase growth: Weaver, E. A. 06234

Phosphate
Tennessee
Pine View quadrangle, occurrence: Wilson, Charles W., Jr. 06225
Pulaski quadrangle, occurrence: Hershey, Robert E. 06210

Photogeology
Methods
Satellites, photoimage maps, EROS program: Fischer, William A. 00352
Panama
Azuera Peninsula, Chitre area, Rio La Villa: Tricart, J. 06077
Azuera Peninsula, Rio Parita delta area: Tricart, J. 06076
Baru Volcano, Rio Escarrea area, hydrovolcanic features: Tricart, J. 06078

Pisces
Devonian
Nova Scotia, Knoydart Formation faunas: Dineley, D. L. 06386
Melanognathus canadensis, n.gen., n.sp.
Devonian, Northwest Territories, Lower: Jarvik, Erik. 06379
Morphology
Dipnoi, jaw structure, Devonian cf. Recent: Jarvik, Erik. 06379
Osteichthyes, vertebrae, evolution: Schaeffer, Bobb. 06380
Osteichthyes
Devonian–Recent, vertebrae, morphology, evolution: Schaeffer, Bobb. 06380
Protaspis (Protaspis) erroli, n.sp.
Devonian, Utah, Water Canyon Formation, northeastern: Denison, Robert H. 06356
Taxonomy
Pteraspididae, genera and subgenera: Denison, Robert H. 06356

Planets
Composition
Mean atomic weight, cf. Earth and meteorites: Anderson, Don L. 06411
Interior
Radiative conductivity, thermal history: Aronson, J. R. 06366
Origin
Problems of analysis: MacDonald, Gordon J. F. 06080
Plutonium
Isotopes
Pu-244 fission tracks, meteorites, cooling rate: Fleischer, R. L. 00298
Polymetallic ores
Canada
Archean sulfides, metamorphism, remobilization: Suffel, G. G. 06273
Popular and elementary geology
Continents
Genesis: Herrin, Eugene. 06081
Crust
Genesis: Herrin, Eugene. 06081
Geodesy
Techniques and problems: Kaula, W. M. 06068
Magnetic field, Earth
Causes, description, paleoform: Elsasser, Walter M. 06066
Magnetosphere
Genesis, form, properties: Axford, W. I. 06067
North Dakota
Eddy and Foster Counties: Bluemle, John P. 06383
Oceanography
General: Bixby, William. 06444
Organic materials
First appearance: Calvin, Melvin. 06069
Sedimentary structures
Colorado, Denver area: MacKenzie, D. B. 00193
Utah
Zion National Park: Hagood, Allen. 06320
Porosity
Carbonate rocks
Genesis, distribution in crinoidal rocks: Lucia, F. Jerry. 06437
Sediments
California, central, subsiding areas: Johnson, A. I. 00312
Precambrian
California
Salt Spring Hills, Kingston Peak, Johnnie, and Stirling Formations: Troxel, Bennie W. 06357
Colorado
Front Range, paleomagnetic pole position, reversals: Eggler, D. H. 00369
Maryland
Piedmont, eastern, Glenarm Series: Southwick, David L. 06327
Minnesota
Granite Falls area, mafic dikes, age of intrusion: Hanson, G. N. 06018
Precambrian
North Carolina
Great Smoky Mountains National Park: King, Philip B. 00263
Northwest Territories
Ellesmere Island, Kennedy Channel and Ella Bay Formations: Kerr, J. William. 06306
Nomenclature, Ellesmere Island: Kerr, J. William. 06306
Quebec
Belleau–Desaulniers area, Grenville and Morin Series: Philpotts, A. R. 06099
Gras Lake–Felix Lake area: Clarke, P. J. 06024
Saint-Gabriel-de-Brandon area: Beland, Rene. 06023
Tennessee
Great Smoky Mountains National Park: King, Philip B. 00263
United States
Great Basin, northeastern, stratigraphy: Condie, Kent C. 06355
Utah
Northern, subgraywackes, tillites(?): Condie, Kent C. 05982
Wyoming
Front Range, paleomagnetic pole position, reversals: Eggler, D. H. 00369
Prince Edward Island
Economic geology
Petroleum, natural gas, possibilities: Williams, E. P. 06365
Protista
Coccolithophores
Neogene, Trinidad, Jamaica, Gulf of Mexico, new species, distribution: Gartner, Stefan, Jr. 06012
Cyclococcolithus leptoporus
Tertiary, Gulf of Mexico, Sigsbee knolls: Gartner, Stefan, Jr. 06011
Dinoflagellates
Cretaceous–Tertiary, California, Moreno Formation, new: Drugg, W. S. 06100
Geographic distribution
Trinidad, Jamaica, Gulf of Mexico, coccolithophores: Gartner, Stefan, Jr. 06012
Nomenclature
Calcidiscus, junior synonym of *Cyclococcolithus*: Gartner, Stefan, Jr. 06011
Tiarolithus, junior synonym of *Cyclococcolithus*: Gartner, Stefan, Jr. 06011
Pteridophytes
Psilophyton forbesii, n.sp.
Devonian, Maine, northern, Trout Valley Formation: Andrews, Henry N. 00362
Sermaya biseriata, n.gen.
Pennsylvanian, Illinois, Berryville coal, morphology: Eggert, Donald A. 06101
Taxonomy
Psilophytes, Devonian, review: Andrews, Henry N. 00362

Quaternary
Alaska
Fairbanks area, permafrost tunnel, Wisconsin section, unconformities: Sellman, Paul V. 06126
Barbados
Coastal terraces, Pleistocene changes in level: Broecker, Wallace S. 00211
California
Salt Spring Hills, southern, sediments: Troxel, Bennie W. 06357
Connecticut
Hartford South quadrangle, Pleistocene deposits: Deane, R. E. 06097
Kansas
Brown County, stratigraphy: Bayne, Charles K. 05980
Neosho River valley, Pleistocene terraces and flood plain deposits: Jamkhindikar, Suresh. 06002
Kentucky
Vertebrata, Pleistocene: Jillson, Willard Rouse. 00367
Nova Scotia
Minas Basin, fluviomarine outwash: Swift, Donald J. P. 06367
West Indies
Sombrero and other islands, Reptilia: Auffenberg, Walter. 06104
Quebec
Engineering geology
Landslides, Toulnustouc River, sensitive clay: Crawford, C. B. 06059
Geomorphology
Saint-Gabriel-de-Brandon area, drainage patterns: Beland, Rene. 06023
Maps, geologic
Belleau-Desaulniers area: Philpotts, A. R. 06099
Chandler—Port Daniel area: Ayrton, W. G. 06326
Gras Lake and Felix Lake areas, Saguenay County: Clarke, P. J. 06024
Saint-Gabriel-de-Brandon area: Beland, Rene. 06023
Petrology
Belleau-Desaulniers area, Precambrian rocks: Philpotts, A. R. 06099
Gras Lake-Felix Lake area, Precambrian rocks: Clarke, P. J. 06024
Saint-Gabriel-de-Brandon area, Precambrian units: Beland, Rene. 06023
Stratigraphy
Paleozoic, Chandler—Port Daniel area: Ayrton, W. G. 06326
Precambrian, Gras Lake-Felix Lake area, general: Clarke, P. J. 06024
Precambrian, Grenville and Morin Series, Belleau-Desaulniers area: Philpotts, A. R. 06099
Structural geology
Chandler—Port Daniel area: Ayrton, W. G. 06326
Radioactivity
Granitic rocks
Caliornia, Sierra Nevada batholith: Wollenberg, Harold A. 00271
Radiolaria
Depth distribution
Skeletal solution, rates: Berger, Wolfgang H. 00309
Geochemistry
Skeletons, solution, rate, variation with depth: Berger, Wolfgang H. 00309
Radium
Isotopes
Ra-226, sea water, distribution: Broecker, Wallace S. 06232
Radon
Isotopes
Rn-222, sea water, distribution: Broecker, Wallace S. 06232
Rare earths
Geochemistry
Igneous and sedimentary rocks, cf. Sc and Fe: Norman, Jack C. 00293
Greenland
Ilimaussaq intrusion, lujavrites, occurrence: Sorensen, Henning. 06275
Reefs
Canada
Devonian, Keg River, Sulphur Point, Slave Point: Hriskevich, M. E. 06236
Caribbean Sea
Miocene, dwarf atolls off Jamaica: Burke, Kevin. 00267
Mexico
Cretaceous, stratigraphic traps: Guzman, Eduardo J. 06438
Reptilia
Geochelone sombrerensis
Pleistocene, West Indies, Sombrero Island: Auffenberg, Walter. 06104
Geochelone spp.
Pleistocene, West Indies, Greater Antilles, distribution: Auffenberg, Walter. 06104
Rivers
Alberta
North Saskatchewan River, gravel bed forms, Drayton Valley area: Galay, V. J. 06159
Channel geometry
Bed-form analysis, meandering cf. straight reaches: O'Loughlin, Emmett M. 06162
Hydraulic variables, engineering problems, interdisciplinary approach: Simons, Daryl B. 06164
Mississippi River, Vicksburg District, energy-roughness relations: Anding, Malcolm G. 06163
Riverbank scour or deposition, Mississippi River, Vicksburg area: Franco, John J. 06170
Erosion
Degradation below dams, prediction: deVries, M. 00303
Degradation below dams, prediction: Egiazaroff, Ivan. 00304

Rivers
Erosion
Degradation below dams, prediction: Gill, Mohammad Akram. 00302
Degradation below dams, prediction: Herbertson, John G. 00300
Degradation below dams, prediction: Peters, John C. 00301
Meanders
Development, model study: Anderson, Alvin G. 06160
Genesis, theoretical treatment: Adachi, Shohei. 06171
Sediment transport
Alluvial channel, bed-material, stochastic model: Sayre, William W. 06165
Alluvial channel processes, stochastic models, application: Nordin, Carl F. 06166
Bed roughness, effects of suspended sediments: Kikkawa, Hideo. 06174
Bed roughness, regime theory parameters, flow formula defects: Blench, T. 06173
Bed-form analysis, meandering cf. straight reaches: O'Loughlin, Emmett M. 06162
Bedload discharge and grain abrasion laws, stabilization: Pirkovsky, M. 06155
Bed-material discharge, method: Chang, Feng-Ming. 06167
Columbia River, Oregon-Washington, bed forms: Whetten, John T. 06310
Degradation below dams, prediction: Peters, John C. 00301
Experimental studies, non-equilibrium flow, bed roughness, effects: Rathbun, R. E. 06169
Gravel bed forms, Alberta, North Saskatchewan River: Galay, V. J. 06159
Hydraulic variables, engineering problems, interdisciplinary approach: Simons, Daryl B. 06164
Mississippi River, Vicksburg District, energy-roughness relations: Anding, Malcolm G. 06163
Sand channels, flow resistance, bed configuration: Richardson, Everett V. 06168
Sand waves, statistical character, relation to bed regime: Ashida, K. 06161
United States
Geochemistry, metallic elements, suspended sediments, western cf. eastern: Turekian, Karl K. 06414
Rocky Mountains
Economic geology
Petroleum, exploration, application of sedimentation data, symposium: Wyoming Geological Association. 06013
Sedimentary petrology
Permian-Pennsylvanian, sedimentation, principles, symposium: Wyoming Geological Association. 06013
Salt
Exploration
Seismic refraction techniques: Musgrave, A. W. 06287
Sand
Tennessee
Reagan quadrangle, occurrence: Hershey, Robert E. 06208
Saskatchewan
Economic geology
Uranium, Beaverlodge area, production, history: Griffith, J. W. 06293
Geophysical surveys
Seismic, application of Dinoseis system: Godfrey, L. M. 00183
Maps, aeromagnetic
Big Sandy Lake area: Canada Geological Survey. 06333
Clarke Lake area: Canada Geological Survey. 06328
Leonard Lake area: Canada Geological Survey. 06337
Little Bear Lake area: Canada Geological Survey. 06332
Meeyomoot Lake area: Canada Geological Survey. 06331
Montreal Lake North area: Canada Geological Survey. 06330
Saunders Lake area: Canada Geological Survey. 06335
Seager Wheeler Lake area: Canada Geological Survey. 06334
Suggi Lake area: Canada Geological Survey. 06336
Wassegam Lake area: Canada Geological Survey. 06329
Scandium
Geochemistry
Igneous and sedimentary rocks, cf. rare earths and Fe: Norman, Jack C. 00293
Sea water
Composition
Radium-226, radon-222, concentrations, Atlantic and Pacific: Broecker, Wallace S. 06232
Evolution
Alkali metals, fractionation, terrestrial control: Harriss, Robert C. 06204
Geochemistry
Heterogeneous equilibria, of major and minor constituents: Schindler, Paul W. 06417
Sedimentary rocks
Carbonate rocks
Diagenesis, Utah-Colorado, Paradox basin: Peterson, James A. 05987
Physical properties, permeability, nonreef stratigraphic traps: Illing, L. V. 06399
Physical properties, porosity, genesis and distribution: Lucia, F. Jerry. 06437
Physical properties, porosity history, determination: Murray, Raymond C. 06014
Conglomerate
Petrology, New Jersey, Trenton area, Triassic basin: Park, Yong Ahn. 06150
General
Diagenesis, effect on porosity and permeability, Williston basin: Miller, D. N., Jr. 06015

Sedimentary rocks
General
General description, Washington, Lake Tapps quadrangle: Gard, Leonard M., Jr. 00313
Sedimentation, diagenesis, relation to oil exploration: Wyoming Geological Association. 06013
Geochemistry
Alaska, Seward Peninsula, western, trace elements, analyses: Sainsbury, C. L. 06362
Graywacke
Petrology, Precambrian tillites(?), Utah: Condie, Kent C. 05982
Limestone
Alteration, selective recrystallization: Chanda, S. K. 06144
Classification, statistical methods: Bonham Carter, G. F. 06400
Lithofacies
Alberta, Lower and Middle Mississippian series: Macqueen, R. W. 06102
Alberta, southern Rocky Mountains, Upper Cambrian: Aitken, J. D. 06140
California, Los Angeles County, Castaic Formation: Stanton, Robert J., Jr. 06390
Colorado, Denver Basin, Pennsylvanian–Permian cyclothems: Momper, James A. 05988
Deltaic, recognition criteria: Donaldson, Alan C. 06017
Iowa–Oklahoma, Altamont Limestone, Pennsylvanian, cyclothem: Schenk, Paul E. 06005
Louisiana, Frio Formation, Hackberry wedge: Paine, William R. 00305
Oklahoma, Moorefield Formation, Lindsey Bridge Member: Swinchatt, Jonathan P. 06409
Utah, Tertiary, lower sequence: Catacosinos, Paul A. 00266
Wyoming, Minnelusa Formation, sonic log data: Allen, Albert E., Jr. 05990
Methods
Statistical analysis, lithologic gradients: Dahlberg, E. C. 06374
Statistical, limestone classification: Bonham Carter, G. F. 06400
Sandstone
Diagenesis, cementation, compaction: Blatt, Harvey. 05986
Experimental studies, sedimentation: Middleton, Gerard V. 06016
Physical properties, permeability, non-uniformities: Polasek, Theo L. 06436
Sedimentary structures
Bedding
Laminae, laminasets, beds, bedsets, definition, genesis: Campbell, Charles V. 06141
Crossbedding
Oklahoma, Moorefield Formation, Lindsey Bridge Member: Swinchatt, Jonathan P. 06409
Pennsylvania, Mauch Chunk Formation: Hoque, Momin ul. 00311
Sedimentary structures
Crossbedding
Thickness, correlation with grain size: Scheidegger, Adrian E. 06429
General
Colorado, Denver area road cut, Dakota Sandstone: MacKenzie, D. B. 00193
North Carolina, Black Creek Formation, tidal features: Swift, Donald J. P. 06324
Ontario, Huronian rocks: Young, Grant M. 00361
South Carolina, Black Creek Formation, tidal features: Swift, Donald J. P. 06324
Submarine canyon sediments: Stanley, Daniel J. 00320
Graded bedding
Utah, Precambrian subgraywackes: Condie, Kent C. 05982
Ripple marks
Geometry, determination, parameters: Tanner, William F. 06040
Stratification
Georgia, barrier islands, Recent: Hoyt, John H. 06148
Sedimentation
Cyclic
Computer model, coal-bearing deltas: Oertel, G. 06041
Environment
Beach, photographic methods: Dolan, Robert. 06408
Delta, facies recognition, cyclic deposition: Donaldson, Alan C. 06017
Island, Nova Scotia, Sable Island: James, Noel P. 06058
Experimental studies
Alluvial channel, bed material particles, stochastic model: Sayre, William W. 06165
Alluvial channel, nonsteady bedload, computation: Vreugdenhil, C. B. 06153
Alluvial channel processes, stochastic models, use: Nordin, Carl F. 06166
Alluvial channels, bed form geometries, meandering cf. straight reaches: O'Loughlin, Emmett M. 06162
Depositional fabric, magnetic and hydrodynamic controls: Hamilton, N. 06371
Sand waves, statistical character, relation to bed regimes: Ashida, K. 06161
Sandstones, dimensional analysis: Middleton, Gerard V. 06016
Stream flow, drag and lift forces on spherical particles: Coleman, Neil L. 06152
Littoral transport
Coastal energy, drift rate, United States, southeastern: Tanner, William F. 06154
Marine
Basin edge, transgressive seas, relation to land transgressed: Stanton, Robert J., Jr. 06390

Sedimentation
Ocean currents
Coastal energy, drift rate, United States, southeastern: Tanner, William F. 06154
Rates
Gamma-ray spectrometry, deep-sea cores: Osmond, J. K. 00208
Stream transport
Alluvial channel, bed-material particles, stochastic model: Sayre, William W. 06165
Alluvial channel, nonsteady bedload, computation: Vreugdenhil, C. B. 06153
Alluvial channel processes, stochastic models, use: Nordin, Carl F. 06166
Alluvial channels, bed-form geometries, meandering cf. straight reaches: O'Loughlin, Emmett M. 06162
Alluvial channels, bed-material discharge, method: Chang, Feng-Ming. 06167
Bed forms, sand wave movements, Columbia River: Whetten, John T. 06310
Bed roughness, non-equilibrium flow effects, experimental: Rathbun, R. E. 06169
Bed roughness, regime-theory parameters, flow formula discordance: Blench, T. 06173
Bed-roughness, effects of suspended sediments: Kikkawa, Hideo. 06174
Gravel bed forms, Alberta, North Saskatchewan River: Galay, V. J. 06159
Longitudinal profile stabilization: Pirkovsky, M. 06155
Meandering rivers, planform analysis, spectral method, Indiana: Toebes, G. H. 06172
Measurement with tracers: Crickmore, M. J. 06147
Mississippi River, Vicksburg District: Anding, Malcolm G. 06163
Sand channels, flow resistance, bed configuration: Richardson, Everett V. 06168
Sand waves, statistical character, relation to bed regime: Ashida, K. 06161
Spherical particles, drag and lift forces of flow, experiments: Coleman, Neil L. 06152
Sediments
Carbonate
Continental shelf, Atlantic Ocean, U.S.: Hulseman, Jobst. 06145
Mineral composition, shape and size analysis, Atlantic coast beaches: Pilkey, Orrin H. 06373
Classification
Zingg system, modification, particle shape classes: Smalley, I. J. 06143
Clay
Geochemistry, ordering of mixed layers, genesis: Hower, John. 06123
Ecology
Lakes, contamination, fossil pollen record, disturbance: Nichols, Harvey. 06060
General
Fabric analysis, Gulf of Mexico, ultrathin sections: Bowles, Frederick A. 00179
Sediments
General
Subtidal gelatinous mat, Great Bahama Bank: Bathurst, R. G. C. 06370
Geochemistry
Gases in interstitial water, measurement technique: Reeburgh, William S. 00359
Marine, clay fraction, isotopic and chemical disequilibrium with ocean water: Harriss, Robert C. 06204
Loess
Physical properties, permeability: Rosen, Milton J. 00342
Methods
Computer program, grain-size data analysis: Schlee, John. 06430
Crushing, effects on heavy minerals: Henningsen, Dierk. 06420
Gases in interstitial water, measurement technique: Reeburgh, William S. 00359
Heavy minerals, separation: Stone, Jerome. 00370
Salt removal, dried cores: Wangersky, Peter J. 06369
Statistical, deviation index, comparative study: Pomerol, Charles. 06425
Organic
General description, continental shelf, California: Uchupi, Elazar. 06146
Organic ooze
General description, precursor to oil shale: Bradley, W. H. 06258
Paleomagnetism
Deep-sea cores, reversals, cf. dated lavas: Opdyke, N. D. 05983
Physical properties
California, central, subsiding areas: Johnson, A. I. 00312
Magnetic susceptibility, silt, flume study: Hamilton, N. 06371
Sand
General description, United States, southeastern shelf: Goodell, H. Grant. 06358
Till
Size analysis, Connecticut, Hartford South quadrangle: Deane, R. E. 06097
Seismic methods
Acoustical monitoring
Landslide noise, prediction: Cadman, John D. 06322
Applications
Petroleum exploration, offshore, streamer receivers: Davis, B. W. 06304
Instruments
Deep-ocean sub-bottom profiling: Waugh, Harry. 06302
Seismograph system, ocean bottom: Ezell, G. Dale. 06303
Interpretation
Reflection records, stratigraphic traps: Boulware, Robert A. 06398
Reflection seismogram, linear filter model: McDonal, F. J. 06453

Seismic methods
Interpretation
Refracted waves, mantle velocity, curvature correction: Mereu, R. F. 00207
Uphole surveys, high-resolution, source and arrival times: Carlson, R. C. 00184
Refraction
Application, mineral exploration, mines: Elliot, Charles L. 06288
Techniques, interpretation, case histories, collected papers: Musgrave, Albert W. 06277
Techniques, salt and shale masses: Musgrave, A. W. 06287
Techniques
Deep ocean sub-bottom profiling: Waugh, Harry. 06302
Dinoseis, application in Canada: Godfrey, L. M. 00183
Marine, low-frequency acoustic sources: Burg, K. E. 06305
Surface sources of energy, petroleum exploration: Johnson, James F. 06448
Seismic surveys
Alabama
Heflin area, ground-water prospecting: Joiner, Thomas J. 06376
Canada
Hudson Bay, refraction: Hobson, George D. 06446
Colorado
Straight Creek Tunnel, pilot bore: Scott, J. H. 00376
Northwest Territories
Crustal studies, Sverdrup basin: Hobson, George D. 06395
Utah
Wasatch trench area, northern: Cook, Kenneth L. 06289
Seismology
Elastic waves
Lg phase, magnitude determination: Baker, R. G. 06072
Rayleigh waves, phase-velocity profile, Colorado to New Mexico: Sherburne, Roger W. 06073
Velocities, Earth interior, density calculation: Howell, B. F., Jr. 06074
General
Explosion seismology since 1963, continental: Steinhart, John S. 06424
Selenium
Geochemistry
Relation to muscular dystrophy in cattle: Allaway, W. H. 06215
Shorelines
Changes
Nova Scotia, postglacial uplift: Swift, Donald J. P. 06367
Silicon
Geochemistry
Radiolarian skeletons, solution rate at depths: Berger, Wolfgang H. 00309
Silurian
Nova Scotia
Shelburne map area, White Rock Formation: Taylor, F. C. 06318
Oklahoma
Trilobita, Henryhouse Formation: Campbell, K. S. W. 06139
Soils
Alaska
Meade River–Colville Delta area, eolian deposits: Rickert, D. A. 06175
Classification
Textural, computer program: Schreiber, H. A. 06264
Tropical, recent developments: VanWambeke, A. 06180
Engineering properties
Clays, sensitive, cyclic stress–strain characteristics: Thiers, Gerald R. 00324
Frost susceptibility, particle size as basis for assessing: Penner, E. 06056
Loess, permeability: Rosen, Milton J. 00342
Sewer-project studies: Greer, David M. 00210
Erosion
Ground-water seepage, slope stability: Rahm, S. Lennart. 06156
Genesis
Mechanisms and changes, selected papers: Drew, J. V. 06382
Tropics, sequences: VanWambeke, A. 06180
Geochemistry
Alaska, Seward Peninsula, western, trace elements, analyses: Sainsbury, C. L. 06362
Anthrax-supporting: VanNess, G. B. 06219
Humic fraction, stability, C-14 data: Campbell, C. A. 06265
Montmorillonite, humic compound, interactions: Kodama, H. 06195
Uranium and thorium, distributions: Hansen, R. O. 00343
Hydrogeology
Ground-water content, hygrometer: Bouyoucos, George J. 06179
Ground-water content, neutron meter, standards: Ursic, S. J. 06181
Ground-water movement, I-131 tracer: Hamid, A. 06178
Neutron water probe: Ursic, S. J. 06181
Mineralogy
Clay minerals, gel formation: Williams, B. G. 06182
Size analysis
Particle distribution, computer program: Schreiber, H. A. 06264
Textbooks
Formation and classification, selected papers: Drew, J. V. 06382
Weathering
Aggregates, size, frost effect: Bisal, Frederick. 06176
Frost depth, measurement methods: Sartz, Richard S. 06177

South Carolina
Geophysical surveys
Coastal plain, gamma-ray logging: Lafferty, William R. 06048
York County, Carroll and Ross sulfide prospect, magnetic: Geyer, Vernon R., Jr. 06047
Maps, mineral resources
Heavy minerals: Overstreet, William C. 00323
Paleontology
Ostracoda, Miocene–Pliocene, Waccamaw Formation: Swain, Frederick M. 00262
Petrology
Piedmont metamorphic rocks: Griffin, Villard S., Jr. 06046
Sedimentary petrology
Coastal plain, Black Creek Formation, tidal deposit: Swift, Donald J. P. 06324
Stratigraphy
Cretaceous, Upper, coastal plain: Swift, Donald J. P. 06324
Structural geology
Piedmont, folding: Griffin, Villard S., Jr. 06046
South Dakota
Stratigraphy
Pennsylvanian–Permian, paleogeography: Maughan, Edwin K. 05989
Spectroscopy
Absorption
Mossbauer, clay minerals, parameters, Fe^{2+} and Fe^{3+}: Pecuil, T. E. 06112
Atomic absorption
Technique, current trends, review: Howie, R. A. 06419
Electron probe
Technique, current trends, review: Howie, R. A. 06419
Infrared
Absorption, montmorillonite, alcohol–water interactions: Dowdy, R. H. 06196
Technique, current trends, review: Howie, R. A. 06419
Mass
Technique, lithium isotopes in meteorite: Gradsztajn, Eli. 00212
Mossbauer effect
Phosphate–iron mixtures, Fe^{+3}:Fe^{+2} ratio: Lerman, Abraham. 00213
X-ray
Technique, current trends, review: Howie, R. A. 06419
Statistical methods
Geomorphology
Variance analysis, Indiana, White River, meander planforms: Toebes, G. H. 06172
Variance analysis, river bed roughness, sand-wave characteristics: Ashida, K. 06161
Variance analysis, river-bed forms, meandering cf. straight reaches: O'Loughlin, Emmett M. 06162
Mineralogy
Markov models, X-ray diffraction analysis data: Blyth, Colin R. 06372
Statistical methods
Petrology
Factor analysis, major-element analyses, basalts, classification: Manson, Vincent. 06240
Factor analysis, trace-element analyses, basalts, classification: Prinz, Martin. 06241
Sedimentary petrology
Deviation index: Pomerol, Charles. 06425
General, limestone classification: Bonham-Carter, G. F. 06400
Multiple nonlinear regression, Atlantic shelf sediments: Goodell, H. Grant. 06358
Variance analysis, graywacke, lithologic gradients: Dahlberg, E. C. 06374
Sedimentation
Variance analysis, river bed roughness, sand-wave characteristics: Ashida, K. 06161
Variance analysis, river-bed forms, meandering cf. straight reaches: O'Loughlin, Emmett M. 06162
Stocks
New Mexico
Santa Rita area, quartz-monzonite porphyry: Nielsen, R. L. 06282
Stratigraphy
Principles
Application, Pennsylvanian–Permian cyclothems, Colorado: Momper, James A. 05988
Techniques
Stratigraphic map diagrams, regional, application to unconformities: Melton, Frank A. 00308
Strontium
Abundance
Fossil teeth and bones: Wyckoff, Ralph W. G. 00292
Sulfur
Geochemistry
Orthorhombic, formed by photosynthetic sulfur bacteria: Truper, Hans G. 06003
Isotopes
S-32 and S-34, fractionation studies, bacterial reduction: Kemp, A. L. W. 00270
Sun
Origin
Problems of analysis: MacDonald, Gordon J. F. 06080
Surveys
Canada Geological Survey
Field work, May–October 1967: Canada Geological Survey. 00368
Texas Water Development Board
Publications list: Texas Water Development Board. 00360
United States Geological Survey
Ground-water research, needs: McGuinness, C. L. 06378
Heavy metals program 1966–67: U.S. Geological Survey. 00356
Tectonics
Areal studies
Alaska, Mendenhall Valley, regional uplift: Barnwell, William W. 00373

Tectonics
Areal studies
North Atlantic, rifting, palinspastic restoration: Webb, Gregory W. 00172
Caribbean region
Carboniferous Mesozoic reconstruction, crustal fracture, rotation: Rod, Emile. 06266
Midoceanic ridges
Atlantic Ocean, geology and geophysics: VanAndel, Tjeerd H. 00286
Processes
Sea floor spreading, recent evidence: Simmons, Gene. 00341
Recent deformation
Arctic, map: Puminov, A. P. 06421

Tennessee
Areal geology
Great Smoky Mountains National Park: King, Philip B. 00263
Economic geology
Construction materials, Scotts Hill quadrangle, chert: Wilson, Charles W., Jr. 06230
Gravel, Chewalla quadrangle, occurrence: Larson, Lawrence T. 06207
Limestone, Beans Creek quadrangle, occurrence: Ferguson, Carl C. 06209
Limestone, chert, Linden quadrangle: Wilson, Charles W., Jr. 06205
Limestone, fluorite, Center Hill Dam quadrangle: Wilson, Charles W., Jr. 06206
Phosphate, gravel, chert, Pine View quadrangle: Wilson, Charles W., Jr. 06225
Phosphate, limestone, chert, Pulaski quadrangle: Hershey, Robert E. 06210
Sand, Reagan quadrangle: Hershey, Robert E. 06208
Zinc, eastern, Ordovician formations, genesis: Ridge, J. D. 06283
Maps, geologic
Beans Creek quadrangle: Stearns, Richard G. 06227
Blue Ridge area: Lesure, Frank G. 00261
Center Hill Dam quadrangle: Wilson, Charles W., Jr. 06206
Chewalla quadrangle: Russell, Ernest E. 06228
Great Smoky Mountains National Park: King, Philip B. 00263
Linden quadrangle: Wilson, Charles W., Jr. 06205
Pine View quadrangle: Wilson, Charles W., Jr. 06225
Pulaski quadrangle: Wilson, Charles W., Jr. 06226
Reagan quadrangle: Russell, Ernest E. 06229
Scotts Hill quadrangle: Wilson, Charles W., Jr. 06230

Tennessee
Paleontology
Conodonts, Mississippian(?), "Hardin sandstone", redescription: Huddle, John W. 00209

Tertiary
Alaska
Upper Chistochina River area, Gakona Formation: Rose, Arthur W. 06314
California
Foraminifera, San Juan Bautista Formation, age: Waters, J. N. 00329
Los Angeles Basin, Pliocene, lower: Conrey, Bert L. 05999
Los Angeles County, Castaic Formation: Stanton, Robert J., Jr. 06390
Palynology, Moreno Formation: Drugg, W. S. 06100
Tehama County, Tuscan Formation and Tuscan Buttes plugs: Lydon, Philip A. 06387
Caribbean region
Echinoidea, Eocene, oligopygoids: Kier, Porter M. 06057
Central America
Southern, paleogeography: Henningsen, D. 06095
Colorado
Powderhorn Black Canyon region, volcanics, stratigraphy: Olson, J. C. 00374
Florida
Echinoidea, Eocene, oligopygoids: Kier, Porter M. 06057
Foraminifera, Chipola Formation: Seiglie, George A. 00337
Louisiana
Southwestern, Frio Formation: Paine, William R. 00305
Nebraska
Western, Oligocene Miocene contact, Wildcat Ridge: Schultz, C. Bertrand. 06033
New Mexico
Chama quadrangle, stratigraphy: Muehlberger, William R. 06384
North Carolina
Ostracoda, Waccamaw Formation: Swain, Frederick M. 00262
North Dakota
Dickinson area, Insecta, Paleocene clay: Fennah, R. G. 00325
South Carolina
Ostracoda, Waccamaw Formation: Swain, Frederick M. 00262
Texas
Coastal plain, Claiborne Group, correlation: Eargle, D. Hoyle. 00357
Jeff Davis County, Mammalia, rhinoceratoid: Harris, John M. 06032
Southern, Gueydan Formation: McBride, E. F. 00346
United States
Mammalia, *Copemys*: Fahlbusch, Volker. 06415

Tertiary
Utah
Northeastern, lower, conformity with Cretaceous: Catacosinos, Paul A. 00266
Washington
Lake Tapps quadrangle, stratigraphy: Gard, Leonard M., Jr. 00313
South-central, Yakima Basalt, upper flows: Schmincke, Hans-Ulrich. 06019

Texas
Hydrogeology
Ground-water resources, water plan: Peckham, Richard C. 00196
Mineralogy
Vermiculite, Llano County, analysis: Kerns, Raymond L., Jr. 06109
Paleontology
Mammalia, Oligocene, Capote Mountain Tuff, Ash Springs: Harris, John M. 06032
Petrology
Southern, Gueydan Formation: McBride, E. F. 00346
Sedimentary petrology
Devonian carbonates, porosity, Andrews South oil field: Lucia, F. Jerry. 06437
Stratigraphy
Eocene, Claiborne Group, correlation, coastal plain: Eargle, D. Hoyle. 00357
Tertiary, Gueydan Formation, southern: McBride, E. F. 00346

Thorium
Abundance
Soils: Hansen, R. O. 00343

Trace-element analyses
Basaltic rocks
Variations: Prinz, Martin. 06241
General
Alaska, Seward Peninsula, western: Sainsbury, C. L. 06362
Igneous rocks
Sc contents, cf. rare earths and Fe: Norman, Jack C. 00293
Plagioclase
Electron microprobe: Corlett, M. 06029
Sedimentary rocks
Sc contents, cf. rare earths and Fe: Norman, Jack C. 00293

Tracks and trails
Mollusca
Recent, river point bars, paleogeography indicators: Pryor, Wayne A. 06325
Pelecypoda
Pholad burrows, California, Monterey Formation: Evans, John W. 06036

Triassic
Greenland
Kap Stosch, Amphibia: Nielsen, Eigil. 06381
New Jersey
Trenton area, basal conglomerates: Park, Yong Ahn. 06150
Northwest Territories
Ellesmere and Table Islands, Brachiopoda, spiriferinid: Logan, A. 06149

Trilobita
Cambrian
Alaska, Jones Ridge Limestone, east-central: Palmer, Allison R. 00264
Phacopidellinae
Silurian–Devonian, Oklahoma, phylogeny: Campbell, K. S. W. 06139
Phacopinae
Silurian–Devonian, Oklahoma, phylogeny: Campbell, K. S. W. 06139
Silurian
Oklahoma, Henryhouse Formation: Campbell, K. S. W. 06139

Trinidad
Economic geology
Oil sands, occurrence, major deposits: Phizackerley, P. H. 06254
Paleontology
Protista, Miocene, Cipero and Lengua Formations, coccolithophores: Gartner, Stefan, Jr. 06012

Unconformities
Interpretation
Stratigraphic map diagrams, regional: Melton, Frank A. 00308
Louisiana
Oligocene, Frio Formation, southwestern: Paine, William R. 00305
Northwest Territories
Cambrian, Ellesmere Island: Kerr, J. William. 06306

United States
Economic geology
Metals, heavy, exploration, U.S. Geol. Survey program 1966-67: U.S. Geological Survey. 00356
Monazite, southeastern, fluvial: Overstreet, William C. 00323
Nickel, occurrence, exploration, mining methods: Boldt, Joseph R., Jr. 06321
Oil sands, occurrence, major deposits: Phizackerley, P. H. 06254
General
International Geological Congress, founding committee, 1876: Thurston, William. 00340
Geochemistry
Rivers, suspended sediments, metallic elements, western cf. eastern: Turekian, Karl K. 06414
Geomorphology
Caves, general, collected papers: Black, Herbert L. 06224
Southeastern coast, sedimentation, wave energy and drift rate, calculation: Tanner, William F. 06154
Hydrogeology
Fluorine content, natural: Fleischer, Michael. 06220
Ground-water research, needs: McGuinness, C. L. 06378
Maps, geochemical
Fluorine content of ground water: Fleischer, Michael. 06220

United States
Paleontology
Mammalia, Tertiary, cricetinids, taxonomy, cf. European: Fahlbusch, Volker. 06415
Sedimentary petrology
Continental shelf, southeastern, sediments: Goodell, H. Grant. 06358
Uplifts
Alaska
Mendenhall Valley, regional, current rate: Barnwell, William W. 00373
Nova Scotia
Minas Basin, compared to sea-level rise: Swift, Donald J. P. 06367
Uranium
Abundance
Soils: Hansen, R. O. 00343
Canada
Reserves, resources, occurrence, production, history: Griffith, J. W. 06293
Exploration
Possibilities: Butler, Arthur P., Jr. 06363
Resources
Possibilities: Butler, Arthur P., Jr. 06363
United States
Reserves, production, mineral economics: Griffith, J. W. 06293
Utah
Areal geology
Zion National Park, popular account: Hagood, Allen. 06320
Economic geology
Oil shale, occurrence, Green River Formation: Donnell, John R. 06259
Petroleum, Uinta basin and central-southeastern, impregnated sandstone: Ritzma, Howard R. 06064
Engineering geology
Dams, Colorado River, Glen Canyon, site geology: Wiegel, Egon. 06096
Geochemistry
Uinta Basin, oil shale, kerogen, Fe/Ni ratio: Houghton, A. Sherrill. 06260
Geophysical surveys
Wasatch trench area, northern: Cook, Kenneth L. 06289
Maps, geologic
Hatch Point quadrangle, northeast quarter: Hinrichs, E. N. 00333
Paleontology
Pisces, Devonian, Water Canyon Formation, new pteraspid: Denison, Robert H. 06356
Petrology
Precambrian, subgraywackes, tillites(?): Condie, Kent C. 05982
Sedimentary petrology
Paradox basin, carbonate mounds, deposition, diagenesis: Peterson, James A. 05987
Stratigraphy
Cretaceous-Tertiary, Uintah County, conformable relations: Catacosinos, Paul A. 00266
Precambrian, Great Basin: Condie, Kent C. 06355
Utah
Structural geology
Wasatch trench, graben, geophysical data: Cook, Kenneth L. 06289
Veins
Greenland
Ilimaussaq intrusion, lujavrites, mineralization: Sorensen, Henning. 06275
Wallrock alteration
Regularities: Boyle, R. W. 06284
Vermiculite
Nevada
Gold Butte area, occurrence: Leighton, F. Beach. 06312
Vertebrata
Kentucky
Pleistocene, Big Bone Lick and general: Jillson, Willard Rouse. 00367
Volcanoes
Arizona
San Francisco Mountain Volcanic Field: Colton, Harold S. 06308
Washington
Areal geology
Lake Tapps quadrangle: Gard, Leonard M., Jr. 00313
Geomorphology
Columbia River, sediment transport, bed forms: Whetten, John T. 06310
Maps, geologic
Lake Tapps quadrangle: Gard, Leonard M., Jr. 00313
Mineralogy
Muscovite, Snohomish County, 3*T* form, structure: Guven, Necip. 05993
Petrology
Jove Peak Orbiculite, igneous metamorphic genesis: VanDiver, Bradford B. 00275
Lake Tapps quadrangle, volcanics, intrusives: Gard, Leonard M., Jr. 00313
South-central, Yakima Basalt, Columbia River Group, upper: Schmincke, Hans-Ulrich. 06019
Weathering
California
Coast Ranges, andesites, saprolite formation, mineralogy: Hendricks, D. M. 06192
Clay minerals
Alkaline solutions, influence: Ferrell, Ray E., Jr. 06197
Soils
Frost action effect: Bisal, Frederick. 96176
Frost depth, measurement methods: Sartz, Richard S. 06177
Well logging
Acoustical
Interpretation, Minnelusa Formation, Wyoming: Allen, Albert E., Jr. 05990
Density
Data, Colorado, oil shale yield, cf. assay yield: Tixier, M. P. 06262
Radioactivity
Instrumentation, theory, South Carolina coastal plain: Lafferty, William R. 06048

Wells and drill holes
Alberta
Waterton gas field, lithologic logs: Herr, R. L. 06103
California
Central, subsiding areas, cores: Johnson, A. I. 00312
Iowa
Basement complex, well sample data: Yoho, W. Herbert. 06031
Decatur County, water well data: Cagle, J. W. 06292
Kansas
Brown County, test-hole logs: Bayne, Charles K. 05980
West Indies
Paleontology
Reptilia, Pleistocene, tortoises, new finds, distribution: Auffenberg, Walter. 06104
Structural geology
Carboniferous–Mesozoic, paleotectonic reconstruction: Rod, Emile. 06266
Wyoming
Economic geology
Mineral resources, Fish Lake quadrangle, limitations: Rohrer, Willis L. 00296
Oil shale, occurrence, Green River Formation: Donnell, John R. 06259
Geochemistry
Trace elements in substrate, relation to nutrition: Diem, Kenneth L. 06214
Maps, geologic
Fish Lake quadrangle: Rohrer, Willis L. 00296
Mineralogy
Clay minerals, Yellowstone Natl. Park, mud pots, alteration sequence: Droste, John B. 06271
Paleomagnetism
Precambrian, Front Range, reversals, pole position: Eggler, D. H. 00369
Stratigraphy
Cambrian–Quaternary, Fish Lake quadrangle, section: Rohrer, Willis L. 00296
Pennsylvanian–Permian, Minnelusa Sandstone, sonic log interpretation: Allen, Albert E., Jr. 05990
Xenon
Geochemistry
Chondritic meteorites, unequilibrated, analyses: Heymann, D. 00297
X-ray diffraction analysis
Data
Andesine, anorthite, superlattice maxima, high-temperature survey: Foit, Franklin F., Jr. 05992
Montmorillonite: Dowdy, R. H. 00344
Montmorillonite, 13, 20 band profile: Mering, J. 06122
Pectolite, structure: Prewitt, C. T. 05995
Vermiculite, dioctahedral, *b* dimensions: Leonard, R. A. 06108
Vermiculite, Texas: Kerns, Raymond L., Jr. 06109
X-ray diffraction analysis
Methods
Automatic data processing, montmorillonite and mica, profile calculation: Ross, Malcolm. 06120
Clay minerals, orienting internal standards: Mossman, M. H. 06187
High-speed technique, lattice spacings, powder samples: Giessen, Bill C. 00175
Interpretation, Markov models: Blyth, Colin R. 06372
Montmorillonite, effect of glycol: Dowdy, R. H. 00344
Preparation techniques, effects, illite: Fenner, Peter. 06222
Yukon
Areal geology
Glenlyon map-area: Campbell, R. B. 06319
Maps, geologic
Glenlyon area: Campbell, R. B. 06307
Glenlyon area: Campbell, R. B. 06319
Glenlyon area, surficial: Campbell, R. B. 06317
Maps, geomorphologic
Glenlyon area, glacial features: Campbell, R. B. 06317
Glenlyon area, glacial features: Campbell, R. B. 06319
Paleontology
Angiosperms, Pleistocene, lupine seeds, laboratory germination: Black, Michael. 06127
Graptolithina, Ordovician, *Bryograptus* Zone: Jackson, D. E. 06050
Zinc
Genesis
Sphalerite replacement of limestone: Holland, H. D. 06280
Illinois
Hicks Dome deposits, genesis: Hall, W. E. 06278
Northwest Territories
Pine Point area, genesis: Folinsbee, R. E. 06286
Tennessee
Eastern, Ordovician formations, genesis: Ridge, J. D. 06283